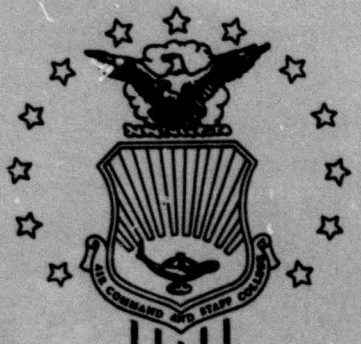

AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

AIRLIFT SUPPORT OF AIRLAND BATTLE DOCTRINE: FOCUS ON REQUIREMENTS, CAPABILITIES, AND THE C-17

MAJOR RICHARD P. HEFFNER 87-1145

"insights into tomorrow"

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This study investigated AirLand Battle doctrine's airlift requirements, airlift capabilities to meet those requirements, and the C-17. Twelve Army and Air Force staff agencies provided data through personal interviews regarding the global theater threat where airlift could contribute most to the support of AirLand Battle operations, the AirLand Battle operation requiring the most airlift support, and the most significant airlift requirements and capabilities supporting AirLand Battle doctrine execution. The nine requirements and eight capabilities were the basis for recommendations to Military Airlift Command for airlift operational and C-17 doctrines that support AirLand Battle doctrine.

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PREFACE

This study focused on the need for complementary airlift and Army doctrines to ensure airlift capabilities fulfilled AirLand Battle doctrine's airlift requirements. The researcher examined general airlift capabilities needed to support suspected AirLand Battle airlift requirements. The researcher specifically focused on the C-17 because the aircraft appeared to incorporate, in a single weapon system, both the strategic and tactical airlift capabilities needed to support all of AirLand Battle doctrine's airlift requirements.

Regardless of the reader's military affiliation, functional expertise, or agreement with the study's research design, the researcher hoped this study of airlift support of AirLand Battle demonstrated two points. First, there is a real need for the Army and Air Force to evaluate their own and each other's foundations for force structure changes or equipment acquisitions--compatible doctrines. Second and more important, joint cooperation and communication are essential to correctly identifying needs and solutions and matching requirements and capabilties in a timely, cost effective manner.

The completion of this research study was not soley an individual effort. The researcher extends a special thanks to the following people and organizations for their time and invaluable advice: Col Shine, USA, Lt Col Hicks, USA, and Lt Col Maddox, USAF, MAC-TRADOC ACRA; Lt Col Schepens, USAF, MAC/XP; Lt Col Bonnell, USA, ACSC; and Maj Newton, the advisor for this study. Finally and most importantly, I thank my wife and three children for all their support and understanding during the past six months, without which success would not have been possible.

ABOUT THE AUTHOR

Major Richard P. Heffner received his Bachelor of Science Degree in Mathematics and commission from the US Air Force Academy in June 1974. His initial assignment was to Undergraduate Pilot Training at Vance Air Force Base, Oklahoma. After earning his pilot wings in July 1975, he remained at Vance as a T-37 Instructor Pilot (IP). In 1977, he was assigned to the 71st Student Squadron, where in addition to his IP flying responsibilities, he was a T-37 Academic Instructor for Aeronautics, Instrument Procedures, and Aircraft Systems. In September 1979, Maj Heffner attended C-5 initial training at Altus Air Force Base, Oklahoma, followed by assignment to the 3rd Military Airlift Squadron, Dover Air Force Base, Delaware. While flying the C-5 he also served as Squadron Plans Officer and as Executive to the Vice Wing Commander. In June 1982, Maj Heffner departed Dover to attend the AF Institute of Technology (AFIT), School of Systems and Logistics. He graduated in September 1983, receiving a Master of Science Degree in Logistics Management, focusing on the study of Contracting and Acquisition Management. He was then assigned to Electronics Systems Division (ESD), Directorate of Contracting, Hanscom Air Force Base, Massachusetts as a systems contract negotiator. In May 1985, Maj Heffner became a warranted contracting officer. As a contracting officer, Maj Heffner was responsible for the procurement of numerous intelligence, command, control, communications, and countermeasures systems, funded by the Air Force, Army, and Marines. In 1986, he was selected to attend the Air Command and Staff College. Maj Heffner's education also includes a Masters in Business Administration from Southern Illinois University at Edwardsville. He is a Honor Graduate from the AF Academy, a Distinguished Graduate from AFIT and Southern Illinois University. Additionally, Major Heffner is a Distinguished Graduate of Squadron Officer School.

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REPORT NUMBER	87-1145
AUTHOR(S)	MAJOR RICHARD P. HEFFNER, USAF
TITLE	Airlift Support of AirLand Battle: Focus on Requirements, Capabilities, and the C-17.

I. Problem: The Army is modernizing and modifying its forces and equipment within the framework of AirLand Battle doctrine. At the same time, the Air Force is pursuing an overall airlift modernization effort designed to remedy the documented strategic airlift shortfall and meet the Army's requirement to airlift light forces and equipment directly to the battlefield. The Services agree joint cooperation is necessary for the development of affordable weapons systems that address compatible airlift requirements and capbilities. However, there is no empirical evidence to show the Services agree on the airlift requirements and capabilites needed to support AirLand Battle doctrine.

II. Objectives: First, the research identified the environmental, operational, and airlift factors that could positively influence the successful outcome of AirLand Battle operations. Second, the study produced a set of recommendations MAC should consider for airlift operational and C-17 doctrines that support AirLand Battle doctrine.

III. Data: The researcher collected data from 12 Army and Air Force staff agencies using a standardized interview technique.

IV. Analysis: The analysis used descriptive and nonparametric statistical techniques.

V. Findings: The analysis produced three primary findings. First, the study identified the environmental, operational, and airlift factors that could contribute most to successful AirLand Battle doctrine execution. Second, nonparametric analyses revealed intraservice and interservice agreement regarding the ranking of airlift requirements and capabilities supporting AirLand Battle operations. Third, the statistical analysis identified nine airlift requirements and eight capabilities considered by the sample to have the most significant positive influence on the support of AirLand Battle doctrine. Additionally, there were several corollary and tertiary findings.

VI. Conclusions: The staff agencies had similiar views regarding air defense threats and theaters, AirLand Battle operations requiring airlift support, and airlift missions that could contribute most to successful AirLand Battle operations. Airlift could contribute most in a medium threat-contingency theater, tactically supporting close operations, and providing direct, strategic delivery deployment of CONUS light forces. Furthermore, airlift aircraft must have the strategic and tactical capability to move forces and equipment, including outsize, in a low-medium threat environment to small, austere airfields at night and in adverse weather.

VII. Recommendations: Air Force and MAC should consider consolidating the separate strategic and tactical airlift operational doctrines into a single 2-series manual. Furthermore, a single office of primary responsibility should be identified to oversee all airlift doctrine, equipment, and training to support Army doctrine. Additionally, airlift 3-series manuals should address theater air defense threats, onboard defensive systems, and coordination with Army-TAC J-SEAD initiatives. Moreover, airlift doctrine and resultant aircraft hardware should stress a complete night, adverse weather capability to fully support AirLand Battle doctrine. Finally, the Army and Air Force should annually review AirLand Battle doctrine, the Army 21 concept, and airlift doctrines to prevent costly and unproductive force restructures or hardware acquisitions.

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THE RESEARCH PROBLEM

INTRODUCTION

Since the Reagan Administration took office six years ago, the health of the United States military has received increased attention from senior government and military leaders. With the growing realization of nuclear parity between the US and the Soviet Union, the US placed increased emphasis on US general purpose forces to support a conventional strategy that protects vital US and allies' interests. Accordingly, one of four defense priorities initially established by the Administration, and pursued today, was the modernization of US general purpose forces to counter a numerically superior Soviet conventional threat. Accompanying this modernization was, and continues to be, the enhancement of US capability to rapidly airlift US forces to distant theaters of operation (17:43). Consequently, senior government and military leaders focused attention on the Army's AirLand Battle doctrine, the associated force restructure, equipment modifications, and US airlift capabilty.

AirLand Battle doctrine addresses the challenge of deterring and if necessary defeating adversaries ranging from numerically superior Soviet and Warsaw Pact forces to similarily equipped Soviet surrogate forces or insurgents. The doctrine expresses the Army's belief that seeking and exploiting the intiative, attacking the enemy to its full depth, and synchronizing combat power are the keys to the Army's qualitatively superior forces prevailing over numerically superior enemies (20:579). To that end, AirLand Battle doctrine provides the framework for the Army to evaluate its force structure, equipment, and deployability requirements.

Within the framework of AirLand Battle doctrine, the Army initiated numerous force structure and equipment initiatives to provide greater flexibility to execute AirLand Battle doctrine across the entire spectrum of conflict and increase strategic mobility (20:716). From existing divisions, the Army created Light Infantry Divisions capable of being airlifted in approximately 500 C-141 sorties (20:581,716). These light divisions provide the US with a rapidly, strategically deployable

force with sufficient lethal capability and a relatively austere support base. Additionally, the light divisions permit early employment of forces in a developing situation aimed at controlling a possible conflict at its lowest level, while still being able to execute Army doctrine (20:716). Equipment modernization efforts include replacing M60 tanks with M1s, substituting Bradley Fighting Vehicles for M113 Armored Personal Carriers, fielding of AH-64 Apache helicopters to replace Cobras, and adding the Multiple Launch Rocket System (17:47; 20:581,716). But, while the Army pursues force restructures and new equipment procurements within a doctrinal framework, the lack of strategic mobility continues to be a constraint to fulfilling Army missions and AirLand Battle doctrine (18:518-523).

Airlift is the cornerstone of Army force projection during initial deployment and the key to sustainment during the initial days of employment. The Army depends on airlift until sealift takes effect and begins to deliver large quantities of heavy equipment and bulk cargo; times may range from 15-20 days in a North Atlantic Treaty Organization (NATO) scenario, to 30-40 days in a non-NATO area like Southwest Asia (19:3954). Furthermore, AirLand Battle doctrine support will require rapid airlift of forces and equipment to and within the theater area and laterally across theaters. Additionally, because of the Army's equipment modernization efforts, in accordance with doctrine, much of the combat equipment is outsize. Therefore, to fully support Airland Battle doctrine, airlift aircraft must be capable of carrying all major Army equipment, including outsize, into small, austere airfields as far forward as brigade level (19:3917-3952).

Being the principal airlift user, the Army responded to Senate Armed Services Committee questions concerning capabilities an airlift aircraft must have to meet the Army's most urgent needs. Capabilities included intertheater, direct delivery into austere airfields; intratheater delivery of outsize cargo to austere airfields; airland, airdrop, and parachute extraction of the full range of key modernized equipment; and intertheater performance with intratheater capability to allow transistion to an intratheater role after the initial deployment phase. Additionally, the Army emphasized the need to rapidly close battalion and brigade forces. Moreover, the Army stated the C-17's outsize equipment and small, austere airfield capabilities best satisfied the majority of the Army's intertheater and intratheater airlift requirements (18:581).

Congress and the US Air Force were and are equally concerned with the airlift shortfall. Since 1974, at least 18 major mobility studies concluded airlift requirements far exceed airlift capabilities (13:4). The most recent and significant intertheater airlift study, The Congressionally Mandated Mobility Study (CMMS) quantified the intertheater shortfall and set as a

goal the capability to airlift 66 million ton miles per day (MTM/D). Meanwhile, several intratheater studies identified the need for greater airlift capability to and within the main battle area and critical combat resupply (19:3911). The release of the Worldwide Intratheater Mobility Study should provide a more definitive analysis of intratheater requirements and shortfalls.

Responding to AirLand Battle requirements and the CMMS goal, the Air Force embarked on a airlift modernization program to remedy the strategic and tactical airlift shortfalls. Based on the CMMS goal of 66 MTM/D and a minimum intratheater capability of 9,000 tons per day, with a goal of 13,500 tons per day, the Air Force remedy includes the C-5 upgrade, refurbishment of the C-130A, increased KC-10 and Civil Reserve Airlift Fleet contributions, and the C-17 (19:3914; 21:4603). But, while all the efforts are an integral part of a general modernization and expansion effort, the C-17's specific capabilities should fulfill the Army's requirement for support of forces and equipment based on AirLand Battle doctrine.

The C-17 addresses AirLand Battle requirements to airlift forces and equipment, including outsize, directly into small, austere airfields to exploit the basic tenets of AirLand Battle doctrine--initiative, agility, depth, and synchronization. Reciprocally, the Army views the C-17 as the key to optimizing the strategic utility of the Light Infantry Division, expects the C-17 to project and sustain forces to the brigade level, and fully supports the C-17 acquisition (19:3952; 21:4617).

Army support of Air Force airlift efforts and Air Force acknowledgement of AirLand Battle doctrine's airlift needs are in two Army-Air Force memorandums. The Memorandum of Understanding on Joint USA/USAF Efforts for Enhancement of Joint Employment of the AirLand Battle Doctrine, 21 April 1983, recognizes the need for joint cooperation to ensure successful execution of AirLand Battle doctrine. Within the memorandum's general understanding are specific objectives to increase interservice discussion on AirLand Battle doctrine and further cooperate in the development and coordination of airlift requirements to meet AirLand Battle mobility needs (11:--). The Services' acknowledgement of the importance of fielding affordable and compatible airland combat forces is further evident in the Memorandum of Agreement on US Army-US Air Force Joint Force Development Process, 22 May 1984. The memorandum's Initiative 30 established the requirement for a joint office to determine intratheater airlift requirements (10:7). The resultant Military Airlift Command-Training and Doctrine Command (MAC-TRADOC) Airlift Concepts and Requirements Agency (ACRA) addressed the airlift requirements and capabilities needed to support AirLand Battle doctrine in its Qualitative Intratheater Airlift Requirements Study (QITARS). Defining the Air Force intratheater airlift capabilities and missions needed

to support Army doctrine, QITARS attempted to make specific comments regarding airlift requirements based on doctrine and capabilities (14:I-1). But, the study did not contain any evidence that the Army and Air Force agreed with the conclusions.

PROBLEM STATEMENT

The US Army is modernizing and modifying its forces and equipment within the framework of AirLand Battle doctrine. General airlift requirements are direct, strategic deployment; rapid, tactical mobility; and delivery of forces and outsize cargo into small, austere fields to brigade level. Both Services view the C-17 as the intertheater and intratheater airlifter with the capabilities that meet the Army's doctrinally derived airlift requirements. While the Army fully supports the C-17 and the Services agree joint positions on airlift programs are necessary, there is no known empirical evidence showing the Services agree on specific airlift requirements and capabilities that support AirLand Battle doctrine.

RESEARCH OBJECTIVES

The study's first objective was identification of the operational environment where airlift could contribute most to the support of AirLand Battle doctrine. The second objective was identification of the most significant airlift requirements and capabilities that could contribute to successful AirLand Battle doctrine execution. The final objective was development of recommendations that Military Airlift Command (MAC) should consider for airlift operational and C-17 doctrines that support AirLand Battle doctrine.

BACKGROUND

Airland Battle Doctrine

AirLand Battle doctrine in FM 100-5 establishes the basis for force design, materiel acquisition, Army professional education, and training. Based on four rudimentary tenets-- initiative, agility, depth, and synchronization--the doctrine is corps oriented for close, rear, and deep operations (16:15).

Close, rear, and deep operations demand synchronization from corps down through all subordinate command levels. From a corps perspective, close, rear, and deep operations at division or brigade levels comprise the corps' close operations. Likewise, the close, rear, and deep operations at brigade and lower levels

would be practically indistinguishable from each other, although distinguishable to the corps (16:19).

In the simplest form, close operations entail maneuver, close combat, and combat unit support (16:19). Successful force employment depends on the timely movement of forces, equipment, and supplies. Consistent with AirLand Battle's basic tenets, forces require rapid shifting to act faster than the enemy and to bring maximum firepower to the decisive battle point. Corps commanders maneuver brigades between divisions or corps, while brigades maneuver battalions (16:36-38). At the tactical level, with distances usually less than 150 kilometers, battalion maneuver will probably be accomplished by Army organic assets. However, at the operational level, where distances could extend to several hundred kilometers, Air Force fixed wing airlift permits rapid deployment and employment (14:IV-13).

Rear operations result from the Army's need to protect combat resources, sustainment bases, and lines of communication, while the enemy is attempting to disrupt or destroy those activities (14:C-9; 16:39). Army forces usually have sufficient reserves and organic mobility to counter rear area attacks. However, at the operational level, with Army forces employed over vast geographical areas, Air Force airlift may be required to rapidly move battalions of light forces to counter enemy attacks. Upon successful defense of the Army's rear area, it may become necessary to airlift engineers and outsize repair equipment to restore rear area storage facilities and transportation links (14:IV-20 - 21).

Finally, AirLand Battle doctrine stresses the contribution of deep operations. Directed against enemy forces not in direct combat contact, deep operations influence the battle situation which in the future will affect the outcome of close operations (16:19). Primarily conducted beyond the Army's Forward Line of Own Troops (FLOT), deep operations into the enemy's rear area may require deployment and emergency sustainment of Army troops by Air Force fixed wing airlift aircraft (14:IV-21 - 32).

Air Force Doctrine

Air Force Manual 1-1 (AFM 1-1) Basic Aerospace Doctrine of the United States Air Force contains the broad guidance on the employment of US air forces. Besides being the foundational doctrine manual, AFM 1-1 also is the basis for the development of Air Force operational and tactical doctrines which are contained in the 2-series and 3-series manuals.

The 2-series manuals contain operational doctrines and describe the proper use of air forces in relation to force objectives and capabilities, mission areas, and detailed mission descriptions (9:vi). Ultimately, basic and operational doctrines form the basis for specific systems' tactical doctrines.

The 3-series manuals prescribe tactical doctrines applicable to specific systems. Based on particular tactical objectives and conditions, the tactical doctrine contained in a 3-series manual concentrates on a specific system's employment (9:iv).

Focusing on airlift support of AirLand Battle doctrine, Air Force basic doctrine states airlift objectives are the deployment, employment, and sustainment of forces through airlanding, airdrop, or extraction (9:3-5). Furthermore, through mobility operations, a commander can maneuver combat forces to exploit an enemy's weaknesses. Therefore, AFM 1-1's discussion of airlift is oriented toward the timely movement and delivery of forces and equipment to support military objectives, from both a strategic and tactical perspective (9:3-5).

Strategic or intertheater airlift, described in AFM 2-21, would support AirLand Battle through the rapid deployment of combat forces, equipment, and supplies from the Continental United States (CONUS) to the employment area. Traditional intertheater airlift originates from the CONUS and terminates at some distance from the main battle area. Thus, AFM 2-21 does not address the AirLand Battle requirement for direct delivery to small, austere airfields as far forward as brigade level (8:--). But, with the Army's light forces and AirLand Battle's reliance on initiative and agility strategic airlift may have to deliver forces from the CONUS directly to the intended employment area. This will be necessary not only to fully execute the Army's doctrine, but also to control a conflict at the lowest level.

On the other hand, airlift operational doctrine contained in AFM 2-4 does address AirLand Battle doctrine's intratheater airlift requirements. Specifically, tactical airlift doctrine specifies airlift will deliver forces, equipment, and supplies on a sustained basis to brigade level and further forward, if required to support the Army's combat mission (7:3-4).

Therefore, Air Force basic and operational doctrines do generally contain the broad guidance on the proper use of airlift relative to support of AirLand Battle doctrine. While excluding direct delivery to the employment area, strategic deployability and theater mobility are evident in the basic airlift mission definition in AFM 1-1 and in tactical and strategic airlift operational doctrines. However, all of AirLand Battle doctrine's airlift requirements and capabilities are not fully discussed.

The C-17 Aircraft

The C-17 is one answer to the documented problem of US strategic airlift shortfall and the requirement to provide rapid delivery and support of Army forces and equipment developed within the framework of AirLand Battle doctrine.

The Congressionally Mandated Mobility Study (CMMS) concluded rapid, strategic force deployment was essential (15:7). Directly related, the Secretary of Defense's Annual Report to Congress for Fiscal Year 1987 recognized the increasing importance of non-NATO force projection capability, especially deployment to Southwest Asia (17:37). Furthermore, a worldwide airfield study in 1981 revealed that 70 percent of the airfields outside the US were less than 4,000 feet in length; this length limits the airlift capability of the C-141 and C-5 aircraft (15:13). Thus, the growing importance of US force projection to Third World areas and the limitation on airland delivery because of runway environment revealed the need for additional airlift capability. Moreover, while all the specific airlift requirements and capabilities to support Army doctrine were not yet identified, accompanying force restructure and equipment modifications indicated the general requirement for intertheater and intra-theater airlift of forces and equipment, including outsize, as close to the employment area as possible (15:17; 19:3912). Translated into aircraft capabilities these general airlift requirements appeared in the C-X Request for Proposal (RFP) as:

a. Intercontinental and intratheater delivery of the full range of combat equipment including outsize.

b. Airlift operations through small, austere airfields 3000 feet in length.

c. Airdrop of combat forces and equipment.

d. Design for survivability (15:18).

United States contractors' reply to the C-X RFP lead to the McDonnell Douglas Aircraft Company's C-17 aircraft. Presently in the full scale development phase, the C-17's planned capabilities fulfill Army doctrine requirements and include (12:13-23):

a. Direct delivery into small, austere fields 3,000 feet long.

b. Outsize, airland, airdrop, and Low Altitude Parachute Extraction System capabilities.

c. Low altitude, high speed airdrop capability.

d. Design redundancy for survival in a hostile environment.

Hence, the C-17 aircraft promises to provide the intertheater and intratheater outsize capabilities, with designed survivability, necessary to directly deliver forces, equipment, and supplies in support of AirLand Battle doctrine.

RESEARCH QUESTIONS

Three research questions provided the framework for guiding the research investigating airlift support of AirLand Battle doctrine.

1. Are there significant differences between the Army and Air Force regarding the environmental, operational, and airlift factors that describe "where and how" airlift support could contribute the most to successful AirLand Battle operations?

2. What airlift factors could most significantly influence the successful outcome of AirLand Battle operations?

3. What airlift requirements and capabilities should MAC consider for development of airlfit operational and C-17 doctrines that directly support AirLand Battle doctrine.

SUMMARY AND RESEARCH OVERVIEW

This chapter presented the Army's AirLand Battle doctrine, Air Force airlift doctrines, and planned C-17 capabilities. AirLand Battle's resultant force restructure, equipment modernization, and requirement for rapid intertheater and intratheater mobility place heavy demands on existing Air Force airlift. The Air Force supported by the Army views the C-17 as the best solution to meeting Army doctrine requirements. The researcher's prime objective was development of recommendations for MAC to consider for airlift operational and C-17 tactical doctrines to support AirLand Battle doctrine. This chapter concluded with a set of three research questions that were the framework for the research study.

Chapter Two describes the research methodology, data collection, and analyses. The third chapter discusses the data analysis and findings. Chapter Four presents the conclusions and recommendations for airlift doctrines that support Army doctrine.

Chapter Two

RESEARCH METHODOLOGY

INTRODUCTION

The first chapter presented AirLand Battle doctrine and its general airlift requirements, Air Force airlift doctrine, and the Air Force's ability to meet the Army's airlift needs. To support the full array of forces and equipment developed within the framework of AirLand Battle doctrine and remedy documented intertheater and intratheater airlift shortcomings, the Army and Air Force decided on the C-17. While senior Army and Air Force leaders support planned C-17 capabilities as fulfilling Army airlift requirements, there is no empirical evidence demonstrating the two Services agree on specific airlift requirements and capabilities to support AirLand Battle doctrine.

THE UNIVERSE

For this research study, the universe consisted of all Army and Air Force organizations required to submit inputs regarding airlift requirements and capabilities related to AirLand Battle doctrine. The Services' organizations range from Army corps and division staffs, to Air Force numbered Air Forces and Military Airlift Command (MAC) flying wings, to Department of the Army and Air Force staff agencies.

TARGET POPULATION

Within the defined universe, there are several Army and Air Force staff agencies with responsibility for determining AirLand Battle's airlift requirements and capabilities. For this study, the researcher considered the Army and Air Force staff agencies with the multi-functional expertise to examine the operational, doctrinal, transportation, and logistical aspects of AirLand Battle and airlift support representative of the target population. The researcher also considered the elements of the target population representative of the universe.

The researcher initially identified the staff agencies by contacting the Military Airlift Command-Training and Doctrine Command Airlift Concepts and Requirements Agency, (MAC-TRADOC ACRA) Scott Air Force Base, Illinois. ACRA, the focal point for Army-Air Force investigation of airlift support of AirLand Battle doctrine, provided the staff agencies whose responsibility encompassed the area of this research. The researcher subsequently contacted each ACRA designated staff agency to verify the agency did have the responsibility and expertise to study the entire range of functional considerations regarding airlift support of AirLand Battle and have each agency designate other Army and Air Force agencies known to be involved in the research area. The researcher's investigation identified the target population as 22 staff agencies consisting of 2 mutually exclusive subgroups of 13 Army and 9 Air Force staff agencies.

RESEARCH STAGES

The overall research plan involved three stages. Stage I was the field research stage, Stage II was the analysis and identification stage, and Stage III was the recommendations and evaluation stage. During Stage I, the researcher collected the information necessary to identify the airlift factors applicable to Research Questions 1 and 2. The analysis and identification stage answered Research Questions 1 and 2 and provided the necessary information for Stage III. The recommendations and evaluation phase answered Research Question 3 and fulfilled the primary research objective-- providing recommendations to MAC for airlift operational and C-17 doctrines that support AirLand Battle doctrine. The following sections of this chapter fully develop the stages.

Stage I--Field Research

The field research stage consisted of one-time personal interviews with respondents representing each Army and Air Force staff agency to obtain data as the input to the Stage II statistical analysis. An interview schedule, completely described in a following section, was the data collection instrument used during the field research stage.

Stage II--Analysis and Identification

Stage II had a two-fold objective. First, using Stage I data, the researcher determined if there were any differences between the two subgroups regarding the description of the AirLand Battle operational environment. Second, the researcher analyzed the airlift factors (requirements and capabilities)

contributing to successful AirLand Battle doctrine operations. The researcher used the Kendall coefficient of concordance, the Kendall Tau coefficient, the Wald-Wolfowitz test, the multiple comparisons test, and a criterion test the researcher developed.

The Kendall coefficient of concordance determined if agreement existed among the rankings of airlift factors by the respondents in each of the two mutually exclusive subgroups.

Next, the Kendall Tau coefficient verified that agreement existed between the two mutually exclusive subgroups regarding their rankings of the airlift requirements and capabilities.

The Wald-Wolfowitz method verified the two subgroups were from identical populations. This permitted the generalization of the findings to the target population.

Finally, the researcher identified the most significant airlift requirements and capabilities (airlift factors) using a 90/75 percent criterion test and the multiple comparisons test.

Thus, the researcher used the results of the analysis and identification stage to establish the relative importance of airlift factors as input to Stage III of the research.

Stage III---Recommendations and Evaluation

The most significant airlift requirements and capabilities identified during the Stage II analysis were the researcher's basis for recommendations regarding airlift operational and C-17 doctrines that support AirLand Battle doctrine. The MAC-TRADOC ACRA then evaluated the recommendations. The Army-Air Force "field experts'" review validated the practical usefulness of the researcher's recommendations for airlift doctrines that support AirLand Battle doctrine.

RESEARCH DESIGN

Research design has many definitions. Selltiz stated that research design is the arrangement for data collection and analysis in a manner that focuses relevance on the research purpose and achieves economy in procedure (4:50). Another definition provided by Kerlinger is that "research design is the plan, structure, and strategy of investigation conceived so as to obtain answers to research questions and to control the variance" (3:83). For this research study, the research design was the investigative plan, structure, and strategy, recognizing time constraints, existing data, and the field environment.

The investigative plan refers to sources and types of information relevant to research questions (3:83). Chapter One described Army AirLand Battle doctrine as the authoritative foundation for force restructure, equipment modernization, and the source for the need to rapidly airlift forces and equipment to and within theaters to brigade level.

The research structure is the outline, scheme, and model of the operation of research variables (3:300). The absence of related empirical studies of airlift support of AirLand Battle doctrine required the development of a research structure to provide the framework for understanding airlift factors and support of the Army's doctrine.

Research Questions 1 and 2 focused on specific airlift factors the researcher suspected could influence the success of AirLand Battle operations. Answering Research Question 1 characterized the environment where airlift support could most contribute to the support of AirLand Battle doctrine. Answering Research Question 2 identified AirLand Battle's most significant airlift requirements and capabilites. These airlift factors provided the framework for the researcher's recommendations which answered Research Question 3. Subsequent evaluation of the recommendations by "field experts" validated the Research Question 3 answer and provided insight into the recommendations' practical application for MAC's efforts to develop airlift doctrines that support AirLand Battle doctrine.

STAGE I--FIELD RESEARCH

Obtaining accurate data to identify AirLand Battle doctrine's airlift requirements and capabilities required direct discussion between the researcher and each respondent. Consequently, the researcher selected the personal interview for data collection.

Interview Schedule

The researcher collected the data essential to answer the three research questions by conducting personal interviews using the interview schedule in Appendix B.

The interview consisted of three types of questions: fixed alternative questions, five-point Likert-type questions, and open-ended type questions. Fixed alternative questions offered the choice among two or more preselected alternatives and provided the advantage of achieving measurement reliability where alternative answers were known and categories clear-cut (5:316).

The researcher used Likert-type questions to determine the respondents attitudes concerning the requirements under study. Likert-type questions assigned each of the respondents' attitudes a numerical value along a continuum ranging from strongly disagree (1) to strongly agree (5). The numerical value was an ordinal measurement.

Open-ended type questions are appropriate and advantageous when an issue is complicated, the relevant dimensions of the problem are uncertain, or the research focus concerns the respondent's resolution of an issue (5:316). Accordingly, the interview schedule contained space for "comments" as the means to obtain responses in an open-ended manner. Respondents' comments provided information not originally anticipated in the research plan's development and insight into the respondents' rationale for answering Likert-type questions and assigning ranks to the airlift factors studied.

Overall, the interview schedule consisted of a set of structured questions the researcher asked orally with responses recorded in writing. The advantages of the structured interview schedule were questions were asked in a standardized format and sequence, and data collection was not affected by unintentional researcher bias, thereby increasing measurement reliability.

Following initial drafting of the interview schedule the researcher requested the MAC-TRADOC ACRA evaluate the interview schedule for relevance and completeness in the treatment of airlift support of AirLand Battle doctrine. The researcher incorporated the feedback into a revised interview schedule which was the data collection instrument used for the research.

Interview Technique

Generally, the interview time spent with each respondent ranged from 35 to 55 minutes, with the average time being approximately 45 minutes. The researcher conducted the interview sessions as follows:

The researcher introduced himself, the purpose of the interview and the research.

The researcher emphasized all data was to be treated with complete anonymity.

The researcher provided the respondent time to review the provided definitions and interview Sections II and III.

The researcher recorded demographic information to fulfill Section I requirements.

The researcher assured that each respondent understood the structure and method for answering the Likert-type questions and then recorded the respondent's answers and comments.

The researcher introduced Section III and recorded the respondent's rankings and comments.

The researcher explained the structure of Section IV and recorded responses to the fixed alternative questions, rankings, and comments.

The researcher provided the respondent the opportunity to elaborate on any previously provided comments, or introduce any new comments the respondent considered relevant to the study.

The researcher concluded the interview by iterating information obtained was subject to the academic policy of nonattribution.

The Sample

Ackoff explains that disproportionate stratified sampling offers an advantage when comparison of strata is an important research concern, while increased measurement efficiency is realized with equal samples from each stratum (1:110). Additionally, the sample will be a probability sample when the the researcher uses a random method of sample selection to choose the elements from each sample strata (1:52).

The researcher established two mutually exclusive strata (subgroups) based on military service affiliation. Using a random number table, the researcher selected equal sample sizes of 6 staff agencies from each strata within the target population consisting of 13 Army and 9 Air Force subgroups. The researcher subsequently contacted each randomly selected element (staff agency) and requested the name of an officer within the agency who was the "most knowledgeable" regarding AirLand Battle doctrine and Air Force fixed wing airlift. The sampling selection procedure helped assure all respondent officers possessed the expertise necessary to express their respective Service's views concerning airlift support of AirLand Battle doctrine.

The 12 respondents (officers) military service time ranged from 10 to 28 years with an average military service time of 19 years per officer. Of the total service time, the 12 officers had between 1 and 3 years in their present duty assignments; an average of 1.6 years per officer. In the area of the research study--airlift support of AirLand Battle doctrine--the 12 officers' experience with AirLand Battle and Air Force fixed wing

airlift was between 1 and 6 years and 1 and 20 years respectively. The average per officer was 3.5 and 11.5 years. Additionally, the sample's joint assignment experience ranged from none (a single officer) to 9 years with an average of 2.8 years. Overall, the researcher considered the sample experienced with regard to military service, Air Force fixed wing airlift, and AirLand Battle doctrine; Army doctrine only being in formal existence since 1982.

The 12 respondents represented a full range of functional areas. The number of officers in the areas of operations and plans, concepts and doctrine, and transportation/movement requirements were approximately equal (see Table 1). The sample's functional area balance helped assure the data obtained through the interview process was not unduly biased by a particular functional area.

FUNCTIONAL AREA	OFFICERS INTERVIEWED
Operations and Plans	3
Concepts and Doctrine	5
Transportation/Movement Requirements	4
Total	12

Table 1. Sample Representation by Functional Area.

Identification/Definition of Factors

To answer the three research questions, the researcher defined airlift support of AirLand Battle doctrine in terms of environmental, operational, and airlift factors related to the doctrine. The factors provided the basis for the interview schedule questions and resulted from (1) the ACRA's Qualitative Intratheater Airlift Requirements Study, (2) current AirLand Battle and airlift literature, and (3) the suspected relationship between operational environment, airlift factors, and successful airlift support of AirLand Battle operations. The selection of nonparametric statistical tests for data analysis permitted the airlift factors' measurement to be either nominal or ordinal. The researcher established the level of measurement based on the required preciseness for each factor and each factors' role in assessing airlift support of AirLand Battle doctrine. Factor identification, an operational definition, and the respective measurement level follow:

Operational Environment (nominal)--a subjectively derived factor placing airlift support of AirLand Battle operations in a realistic global situation. The determination resulted from the respondents' answers to specific interview questions concerning:

a. Threat-theater (nominal)--a determination of the world area where airlift support could contribute the most to successful AirLand Battle operations; threat-theater spectrum ranged from low threat-contingency to high threat-mature.

b. Type of operation (nominal)--a determination of the AirLand Battle operation where success in the selected threat-theater required the most airlift contribution.

c. Type of mission (nominal)--a determination of the airlift mission in the selected threat-theater for the selected AirLand Battle operation that could contribute the most to the operation's success.

Airlift factors (ordinal)-- a determination by the responses to ranking questions pertaining to specific airlift requirements and capabilities and Likert-type questions pertaining to airlift requirements.

a. Airlift requirements (ordinal)--a determination based on the respondents' rank ordering and degree of agreement regarding 23 deployment, employment, and sustainment airlift requirements.

b. Airlift capabilities (ordinal)--a rank ordering of general airlift capabilities needed to support AirLand Battle operations on a global scale. Likert-type questions were not asked because a specific global area could significantly bias a respondent's attitude toward a specific airlift capability.

STAGE II--ANALYSIS AND IDENTIFICATION

The research analysis and identification stage specifically answered Research Question 1 by qualitatively determining concurrence by the subgroups on the description of the operational environment for airlift support of AirLand Battle doctrine. Analysis using the statistical tests previously presented in this chapter answered Research Question 2. The statistical tests identified the most significant airlift factors and produced the inputs needed to develop recommendations to answer Research Question 3.

The researcher evaluated the advantages of nonparametric tests over parametric tests. Nonparametric tests' assumptions are fewer and much weaker than parametric assumptions, and most nonparametric tests apply to data in at least an ordinal scale

(6:31). Further specific advantages of nonparametric tests were:

Probability statements obtained from most nonparametric tests are exact probabilites regardless of the distribution from which the sample is drawn.

When sample sizes up to N=6 are used, there is no alternative to a nonparametric test unless the exact distribution of the population is known.

Nonparametric tests can treat data inherently in ranks, as well as data whose seemingly numerical scores carry the strength of ranks (6:32-33).

Based on the research design, the researcher considered nonparametric statistical tests appropriate for the analysis.

Kendall Coefficient of Concordance (W)

Gibbons states when "K" judges rank the same set of "N" objects the Kendall coefficient of concordance (W) can test whether or not the "K" sets of rankings are independent and for finding a measure of the strength of the relationship between the rankings (2:300). As a solution to the problem of determining the overall agreement among the Army and Air Force officers' rankings of airlift requirements and capabilities, the Kendall coefficient of concordance provided an index of the divergence of actual agreement from perfect agreement (6:230). Specifically, the value of W reflected the degree of agreement among the Army and the Air Force officers' rankings. A detailed discussion of the calculation of the coefficient of concordance, testing W, and interpreting the value is in Appendix C.

90/75 Percent Criterion Test

The Kendall test did not permit determination of the degree of difference between the rankings. Consequently, the researcher used a criterion of at least 90 percent agreement within either subgroup and 75 percent agreement among the 12 officers in the sample to determine the airlift requirements of AirLand Battle doctrine considered by the sample to have the most positive influence on the outcome of AirLand Battle operations. The criterion test validated the subgroups' rankings and identified the subset of the airlift requirements which was the input to the multiple comparisons test. As discussed previously in this chapter under the airlift factors identification (see page 15) the test was not applied against the airlift capabilities rankings. Appendix D contains a complete discussion of the criterion test.

Multiple Comparisons Test

The researcher applied the multiple comparisons procedure to determine whether significant differences existed among the rankings of the the airlift factors (2:316). The test (discussed in Appendix E) identified the most significant airlift factors that could positively influence the successful outcome of AirLand Battle operations.

Kendall Tau Coefficient

The Kendall tau coefficient is applicable to "K" sets of rankings just as the Kendall coefficient of concordance test applied. However, the Kendall tau method is concerned with the degree of association between pairs of ranks rather than agreement among the rankings (2:275). The Kendall tau coefficient method determined the degree of association between the overall rankings of the airlift requirements and capabilities by the two subgroups. Thus, the researcher demonstrated that even though the two military service subgroups had different military service concerns, both the Army and Air Force subgroups' rankings were associated. The demonstrated association showed that when all the airlift factors were considered simultaneously, the two subgroups were consistent in their rankings despite any differences on a particular airlift factor's rank. A thorough explanation is in Appendix F.

Wald-Wolfowitz Test

The Wald-Wolfowitz test enabled the researcher to determine if the two independent subgroups were from the same population (6:136). The researcher tested the sample's airlift factors' rankings to determine if there were any differences between the subgroups. The test (described in Appendix G) permitted the researcher to determine whether the Army and Air Force subgroups were from the same population. This permitted generalization of the study's findings to the target population.

STAGE III--RECOMMENDATIONS AND EVALUATION

Stage III used the most significant airlift factors as the basis for the researcher's recommendations. The recommendations consisted of a set of doctrinal considerations MAC should consider for development of airlift operational and C-17 doctrines that support AirLand Battle doctrine. To fully answer Research Question 3, the researcher requested "field experts" from the MAC-TRADOC ACRA evaluate the researcher's airlift doctrine recommendations for usefulness in developing airlift doctrines that specifically support AirLand Battle doctrine.

SUMMARY LIST OF ASSUMPTIONS

a. The sample's subgroups independently provided data.

b. Individual interview question responses represented Army and Air Force positions regarding airlift support of AirLand Battle doctrine.

c. A standardized interview technique did not bias the data collection.

d. The medium threat-contingency theater selected as the global environment for the interview questions regarding airlift requirements and capabilities was the world area where airlift would have the greatest probability of successfully supporting AirLand Battle doctrine (14:iv-xiii).

SUMMARY LIST OF LIMITATIONS

a. Because there were no known empirical studies in the area of airlift support of AirLand Battle, no base existed for research replication or research design comparison.

b. Since a limited number of staff agencies investigate the research area, the available sample size was fixed and small.

c. Because of limited time and investigative resources, the study did not consider Army logistical and sustainment capability, fuel availability, and reserve forces; issues of host nation support and overflight restrictions; and the impact of the developing C-17 not being brought to fruition.

d. The study was intentionally unclassified due to the limitations of handling classified material in an academic environment. The air defense threat and airlift survivability were not investigated as limiting factors.

SUMMARY

This chapter presented the research methodology, data collection, and statistical methods used for analysis. Chapter Three discusses the researcher's findings resulting from the application of the discussed statistical methods to the data obtained through personal interviews with respondents from 12 Army and Air Force staff agencies. Chapter Four presents the researcher's recommendations for airlift operational and C-17 doctrines that support AirLand Battle doctrine.

Chapter Three

DATA ANALYSIS AND FINDINGS

SUMMARY OF RESEARCH METHODOLOGY

The research objectives stated in Chapter One were to characterize the operational environment for airlift support of AirLand Battle operations, identify the most significant airlift factors contributing to successful AirLand Battle operations, and develop a set of recommendations for Military Airlift Command (MAC) to consider in the formulation of airlift operational and C-17 doctrines that support AirLand Battle doctrine.

The researcher developed three research questions to guide the research effort. Research Questions 1 and 2 focused on the environmental, operational, and airlift factors the researcher suspected would describe "where and how" airlift support would contribute most to successful AirLand Battle operations. Using a standardized interview schedule, the researcher collected data from a random sample of 12 Army and Air Force staff agencies; 2 equal subgroups were interviewed. Data analysis using descriptive and nonparametric statistics provided the information to answer Research Question 3.

This chapter presents the researcher's primary findings, the data analysis used to answer Research Questions 1 and 2, and the study's corollary and tertiary findings.

RESEARCH QUESTION No. 1

Are there significant differences between the Army and Air Force regarding the environmental, operational, and airlift factors that describe "where and how" airlift support could contribute the most to successful AirLand Battle operations?

Primary Findings

The interview data collected from the 12 Army and Air Force staff agencies provided the information to answer Research Question 1. The data addressed the environment where airlift

could contribute most to successful AirLand Battle operations, the AirLand Battle operation that could require the most airlift support, and the airlift mission that could contribute most to AirLand Battle operations' success. Table 2 summarizes the data analysis by presenting the relevant environmental, operational, and airlift mission factors, the data measurement level, and each factor's descriptive statistic and value.

Global Environment. The Army and Air Force modal responses revealed that a medium threat-contingency theater was the global environment where airlift support could contribute most to successful AirLand Battle operations.

AirLand Battle Operation. The AirLand Battle operation identified by both the Army and Air Force subgroups as requiring the most airlift support was the close operation.

Airlift Mission. The sample's and both subgroups' most frequent response concerning the airlift mission that could contribute most to close operations in a medium threat-contingency theater was direct delivery deployment of forces from the Continental US (CONUS) to the employment area.

			Value by Subgroup	
Factor	Measurement Level	Descriptive Statistic	Army	Air Force
Environment	Nominal			
Threat		Mode	Medium	Medium
Theater		Mode	Contingency	Contingency
Operation	Nominal	Mode	Close	Close
Airlift Mission	Nominal	Mode	Direct Delivery Deployment	Direct Delivery Deployment

Table 2. Research Question 1 Descriptive Data Analysis.

RESEARCH QUESTION No. 2

What airlift factors could most significantly influence the successful outcome of AirLand Battle operations?

First Primary Finding

To answer Research Question 2, the researcher analyzed the data collected from the 12 respondents using the nonparametric statistical methods discussed in Chapter Two. The data consisted of the sample's rankings of 23 airlift requirements (see Appendix B) that could influence the successful outcome of AirLand Battle operations.

Kendall Coefficient of Concordance (W). First, the researcher analyzed the complete sample using the Kendall coefficient of concordance technique. The coefficient of concordance determined if agreement existed within the total sample regarding the ordering of the 23 airlift requirements. Once the researcher determined the sample analysis revealed agreement, then the researcher analyzed the individual subgroups of six Army and Air Force respondents (2:160). The Kendall coefficient of concordance tested the null hypothesis (H_o) that the respondents' rankings were not in agreement, meaning the respondents were applying different basis of evaluation. The alternate hypothesis (H_a) was the respondents' rankings were in agreement. Tests were at the .10 level of significance.

For the sample, the computed value of W was .22886 and the value of the chi-square test statistic was 60.42. The critical chi-square value was 30.81 at the .10 significance level for 22 degrees of freedom. The probability associated with H_o being true was .00002. Thus, the researcher rejected the null hypothesis meaning the sample of 12 respondents did agree on the rankings of the 23 airlift requirements. Essentially, each of the respondents applied the same standard when determining a preferred ordering.

Having determined agreement within the sample, the researcher analyzed the Army and Air Force subgroups using the Kendall coefficient of concordance. Computed values for W and the chi-square test statistic for the Army and Air Force subgroups were .23419; 30.91 and .42434; 56.01 respectively. Tested against a critical chi-square value of 30.81 at the .10 significance level for both subgroups, the probability of occurrence associated with H_o was .09673 for the Army subgroup and .00008 for the Air Force subgroup. Therefore, the researcher rejected the null hypothesis for both subgroups, meaning there was agreement within both subgroups regarding the preferential ordering of the 23 airlift requirements. Table 3 contains the

critical and computed chi-square values and the test results used in determining agreement both within the sample and each of the subgroups.

Having determined the Kendall coefficient of concordance values were significant, the researcher determined the "true ranking" of the requirements using the order of the sum of the ranks (R_j); this was the special application of the Kendall coefficient of concordance (6:238-239). Appendix C contains the sample's and the individual subgroups' rankings.

	ARMY	AIR FORCE	SAMPLE
Degrees of Freedom	22	22	22
W value	.23419	.42434	.22086
Signficance Level	.10	.10	.10
Chi-square, critical	30.81	30.81	30.81
Chi-square, computed	30.91	56.01	60.42
Probability of H_o	.09673	.00008	.00002
Test Result	Reject H_o	Reject H_o	Reject H_o
Agreement	Yes	Yes	Yes

Table 3. Kendall Concordance Results, 23 Requirements.

Kendall Tau Coefficient. The Kendall tau coefficient method (see Appendix F) permitted the researcher to determine the degree of association between the Army and Air Force subgroups' rankings of the 23 airlift requirements. The null hypothesis tested no direct association between the two subgroups' rankings, while the alternate hypothesis stated there was direct association between the rankings.

The 2 subgroups' overall rankings of the 23 airlift requirements were the input for the test. The researcher tested the null hypothesis at the .10 level of significance. The computed z value was 2.11 with an associated probability of the occurrence of H_o being .01743. Since the probability of occurrence was less than the significance level H_o was rejected. Hence, the analysis using the Kendall tau coefficient revealed that the Army and Air Force subgroups were directly associated in their preferred ordering of the airlift requirements. Although the analysis indicated considerable inconsistency in certain airlift requirements' ordering, the two subgroups were consistent in their overall ranking of the airlift requirements, when all the requirements were viewed simultaneously (2:291). Table 4 summarizes the Kendall tau coefficient test results.

z value	2.11
Probability of H_o	.01743
Significance Level	.10
Test Result	Reject H_o
Association Exists	Yes

Table 4. Kendall Tau Results, 23 Requirements.

Wald-Wolfowitz Test. The Wald-Wolfowitz test (see Appendix G) tested the null hypothesis that the two sample subgroups were drawn from the same population, while the alternate hypothesis was that the two subgroups were drawn from different populations. The computed r value and associated z values were 21 and .74554 respectively, with an associated probability of occurrence of the null hypothesis being .22797. Since the probability of occurrence was greater than the level of significance, the null hypothesis could not be rejected. Therefore, the data did not provide sufficient evidence for the researcher to reject that the two subgroups came from the same population. The researcher determined that the evidence did not prohibit the generalization of the sample's preferential ranking of the 23 airlift requirements to the target population. Table 5 contains the Wald-Wolfowitz values.

r value	21
z value	.74554
Probability of H_o	.22797
Significance Level	.10
Test Result	Not Reject H_o
From Same Population	Yes

Table 5. Wald-Wolfowitz Results, 23 Requirements.

90/75 Percent Criterion Test. The special application of the Kendall coefficient of concordance only determined the rank ordering of the 23 airlift requirements. Applying the 90/75 percent criterion test (see Appendix D) to all 23 requirements, the researcher determined the existence of consensus regarding the requirements the sample "agreed" could have the most positive influence on the successful outcome of AirLand Battle operations.

The resulting 12 requirements (followed by r... ...) were direct delivery of a follow-on brigade equivalent of CONUS airborne forces to augment previously employed forces (1); direct delivery of the assault echelon of a CONUS airborne brigade (2); direct delivery of a CONUS light infantry brigade (3); airlift sustainment for all light forces in close operations (4); single lift, intratheater ... drop of an assault echelon of an airborne brigade within 24 h... (5); direct delivery of a CONUS air assault brigade (6) ...irland or airdrop sustainment of petroleum, oil, and lubricants (POL) and ammunition for light forces forward of brigade level (8); airlift sustainment for all light forces in deep operations (9); airland or airdrop sustainment of POL and ammunition for light forces forward of the division level (10); direct delivery of a mechanized battalion (15); complete intratheater airland movement of a mechanized battalion a maximum distance of 2000 kilometers within 24 hours (16); and airland or airdrop of prepositioned equipment and supplies from an Aerial Port of Debarkation or Sea Port of Debarkation (APOD/SPOD) to the division level (17).

Multiple Comparisons Test. The researcher used the multiple comparisons test (see Appendix E) to determine whether significant differences existed among the rankings of the 12 airlift requirements the sample "agreed" could have the most positive influence on the successful outcome of AirLand Battle operations. The test revealed significant differences existed between the rankings of direct delivery of a mechanized battalion; complete intratheater airland movement of a mechanized battalion a maximum of 2000 kilometers within 24 hours; and the airland or airdrop of prepositioned equipment and supplies from an APOD/SPOD to the division level, and the other 9 requirements the 90/75 percent criterion test identified. Thus, the test identified the "most significant" airlift requirements.

Second Primary Finding

The researcher performed identical statistical tests using the data collected on the 10 airlift capabilities with only 1 exception. The sample's rankings and the subgroups' rankings of the airlift capabilities were collectively and individually analyzed using the Kendall coefficient of concordance method to determine whether agreement on the rankings existed within the sample and the subgroups. The Kendall tau coefficient tested for agreement between the Army and Air Force subgroups, while the Wald Wolfowitz test determined whether both subgroups came from the same population. But, the 90/75 percent criterion test was not used, because the researcher concluded that attitudinal data regarding airlift capabilities could be significantly biased by a particular region of conflict. Therefore, Likert-type questions concerning the 10 airlift capabilities were not included in the

data collection. However, the researcher used the multiple comparisons test to identify if any significant differences existed within the sample's ranking of the 10 requirements.

The analysis indicated there was agreement on the rankings both within the sample and each of the two subgroups. The special application of the Kendall coefficient of concordance permitted the researcher to determine the "true order" of the 10 airlift capabilities (see Appendix C). Furthermore, the two subgroups exhibited significant agreement between their respective rankings, and the researcher determined both subgroups came from the same population. Accordingly, the sample's preferential ordering of the 10 airlift capabilities could be applied to the target population. However, there were significant differences between the rankings of airlift mission performance in a nuclear, biological, and chemical environment (9) and airdrop of outsize cargo (10) and the remaining eight capabilities: performance of all airlift missions at night and in adverse weather (1), regular performance of all airlift missions in a low-medium threat environment (2), airland delivery of outsize cargo to austere airfields (3), regular airdrop sustainment forward of division level by containerized delivery (4.5), intratheater reemployment with a 6-hour response time (4.5), low level airdrop (6), airland delivery of bulk fuel with offload directly into vehicles or bladders (7), and occasional performance of all airlift missions in a high threat environment (8). Tables 6,7, and 8 summarize the statistical values relevant to the nonparametric techniques.

	ARMY	AIR FORCE	SAMPLE
Degrees of Freedom	9	9	9
W value	.28822	.36296	.28779
Significance Level	.10	.10	.10
Chi-square, critical	14.68	14.68	14.68
Chi-square, computed	15.56	19.60	31.08
Probability of H_o	.07657	.02055	.00028
Test Result	Reject H_o	Reject H_o	Reject H_o
Agreement Exists	Yes	Yes	Yes

Table 6. Kendall Coefficient of Concordance, 10 Capabilities.

Tau value	.444
Probability of H_o	<.054
Significance Level	.10
Test Result	Reject H_o
Association Exists	Yes

Table 7. Kendall Tau Results, 10 Capabilities.

r value, computed	13
r value, critical	6
Test Result	Not reject H_o
From same population	Yes

Table 8. Wald-Wolfowitz Results, 10 Capabilities.

SUMMARY OF PRIMARY FINDINGS

The primary finding for Research Question 1 was that no differences existed in the data collected on the Army and Air Force subgroups describing the operational environment for airlift support of AirLand Battle operations. The findings for Research Question 2 centered on the agreement by the sample's 12 respondents on the rankings of both airlift requirements and capabilities. The information revealed the airlift factors the sample considered "most significant" to the support of AirLand Battle operations.

COROLLARY FINDINGS

The previously presented primary findings were a basis for answering Research Questions 1 and 2. The following corollary findings resulted from the researcher's analysis of interview questions not discussed under any of the statistical methods and the researcher's interpretation of the respondents' comments, some which appear verbatim in the following paragraphs. The corollary findings provided a more complete description of airlift support of AirLand Battle operations. Therefore, the corollary findings were additional support for the researcher's conclusions and recommendations concerning airlift doctrines that support AirLand Battle doctrine.

First Corollary Finding

The first corollary finding resulted from the researcher's interpretation of the responses to fixed alternative and open ended questions associated with 4 of the 10 airlift capabilities.

First, there was consensus within the sample that airdrop of outsize cargo is an unnecessary airlift capability. Among the specific supporting comments were the lack of a "big requirement" for outsize cargo airdrop and the ineffectiveness of outsize airdrop because of the "lack of survivable airdrop platforms."

Second, the majority of respondents indicated that airland delivery (forward of division level) of bulk fuel with direct offload capability was essential, particularly for emergency resupply of heavy units. However, the respondents strongly stated that airland delivery of fuel forward of division level for heavy units could not be a routine mission because of the large quantities of fuel required by heavy units. Moreover, airland delivery of bulk fuel would be severely constrained by the air defense threat, and aircraft survivability limited by the amount of time the aircraft was offloading fuel. The respondents cited low threat-contingency theaters as the best environment for survivability and mission success.

Third, the optimum airdrop parameters were 300-500 feet altitude and 130 knots airspeed. The sample indicated that such an altitude-airspeed combination provided the "best chance of survivability for airborne forces," while minimizing the detrimental affects of wide dispersion associated with high speed airdrops and small AirLand Battle drop zones. Specifically regarding altitude, the respondents indicated that even at 500 feet a reserve parachute was "useless" with any malfunction meaning a probable loss of life for the airborne person. Regarding airspeed, the respondents recognized the aircraft vulnerability and survivability problems associated with low airspeed airdrops. Additionally, the respondents acknowledged the need to airdrop at faster airspeeds and the Army-Air Force agreement to examine airdrop at 250 knots. However, strong accompanying comments addressed the yet unachieved high speed parachutes and jump technique to improve "the jumper's chances."

Second Corollary Finding

The first corollary finding resulted from the researcher's categorization and interpretation of the respondents' comments provided with the rankings and Likert-type responses regarding the airlift factors. This finding addresses several significant concerns associated with the overall issue of airlift support of AirLand Battle doctrine.

First, the respondents strongly commented on the importance of delivery of light forces from the CONUS directly to the intended employment area. Supporting comments specifically addressed the principles of mass and surprise, but the majority of respondents emphasized the need to rapidly project sufficient force early in a crisis to "show force and deter the enemy from further use of force." The sample viewed rapid force projection requirements and the capability to do so as being most important in global areas where the US has no forward deployed forces (e.g., Southwest Asia). Specifically linked to the Southwest Asia area and the requirement for credible rapid force projection were the respondents' comments that an air assault brigade with its organic airlift was the "ideal choice for initial force deployment." The respondents indicated, to fulfill such a requirement, airlift aircraft must be capable of transporting Army helicopters without significant reassembly at destination.

Second, and directly related to the discussed light force deployment, was the need to airlift nonairborne forces directly to the employment area. The respondents expressed strong disagreement with the distances from the employment area the researcher had selected for data collection purposes. A key point continually made by the sample's respondents was light forces lack organic transportation assets and must be airlifted directly to the employment area.

Third, were the respondents' comments concerning light force sustainment. The comments revealed that the combination of a light force's minimum self-sustaining capability (24-48 hours); the anticipated fluid, nonlinear battlefield envisioned with AirLand Battle execution; rapid movement of small combat units; and poorly developed lines of communication would necessitate light force sustainment by airlift. The respondents' comments highlighted the need for airlift sustainment during the initial days of a conflict, awaiting logistics base establishment.

Fourth, were comments regarding light forces in deep operations. Several respondents indicated that airlift delivery and sustainment of light forces across the Forward Line Of Own Troops (FLOT) would be "critical to the ultimate success of deep operations." However, the respondents expressed considerable doubt over the viability of attempting airlift across the FLOT because of the problems involved with suppression of enemy air defenses, command and control of battlefield airspace, lack of airlift aircraft electronic countermeasures equipment, and the overall problem of airlift aircraft survivability.

Fifth, the sample expressed serious concern over the Army's intention to maximize AirLand Battle operations at night and in adverse weather and the lack of airlift capability to support the requirement. Several comments also focused on Central Europe, the

area for which AirLand Battle was initially developed, and the area's "preponderance for low ceilings and visibility; the war won't wait for good weather."

Sixth, the sample questioned the need for airlift aircraft to be concerned with a flare drop requirement. The predominant comment centered on the "superior night fighting capabilility the US now possesses" and "why have airlift perform a mission that would only compromise the advantage we [the US] now enjoy over the Soviets."

Finally, the sample commented on the requirement for strategic and tactical airlift of mechanized forces. The consensus was that strategic airlift could not mass enough mechanized forces to make a significant difference in a battle's outcome. At the same time, the sample acknowledged the requirement for rapid, tactical airlift of battalion or platoon size mechanized forces to augment light infantry or airborne forces.

TERTIARY FINDINGS

The data collection and analysis produced information not contemplated during the research design, but contributory to the complete study of airlift support of AirLand Battle doctrine. Consequently, all findings related to the research resulting from the data collection warranted reporting.

First, the sample indicated the C-17 is the aircraft that meets the Army's intratheater needs, especially AirLand Battle needs. The C-17's ability to direct deliver outsize cargo to small, austere airfields is paramount to any future combat success. While the C-130 has the small field capability, "it can not carry the necessary payloads." The C-5 can carry the payloads but "can not airland the cargo into small, austere airfields." A particular respondent commented "we [the United States] will be hurting until we get the C-17."

Second, many respondents viewed the single, overall answer to the interview "as being the C-17." However, many respondents questioned the "wisdom of wasting an expensive aircraft and its crew without any air defense countermeasures in world areas with considerable air defense threats."

Third, limited in number, yet considered relevant to the primary research objective, were comments regarding the great difficulty associated with trying to develop airlift doctrine to globally support AirLand Battle doctrine. Any airlift doctrine must be flexible to "be tailored" to meet the unique constraints and requirements of the world's diverse threats and theaters.

SUMMARY

This chapter presented the researcher's primary, corollary, and tertiary findings. The primary findings directly addressed Research Questions 1 and 2, and formed the basis for the researcher's conclusions and recommendations. The corollary and tertiary findings provided further support for the researcher's conclusions and recommendations in Chapter Four and resulted from the researcher's interpretation of all the data relevant to study.

Chapter Four

CONCLUSIONS AND RECOMMENDATIONS

SUMMARY OF RESEARCH METHODOLOGY

The research objectives discussed in Chapter One were to characterize the operational environment where airlift could contribute most to the support of AirLand Battle doctrine, identify the airlift factors that could contribute the most to the support of AirLand Battle doctrine, and develop a set of recommendations for Military Airlift Command (MAC) to consider in the formulation of airlift operational and C-17 doctrines that support AirLand Battle doctrine.

The research effort consisted of three stages. Stage I was field research, Stage II was data analysis and identification, and Stage III was the recommendations and evaluation stage. Three research questions guided the research. Research Question 1 determined if there were any differences between the Army and Air Force regarding the environmental, operational, and airlift factors that could describe "where and how" airlift would support AirLand Battle operations. Research Question 2 determined the airlift factors that could most significantly influence the outcome of AirLand Battle operations. Research Question 3 focused on recommendations MAC should consider for airlift operational and C-17 doctrines that support AirLand Battle doctrine.

During Stage I, the researcher collected data from a random sample of two equal subgroups of Army and Air Force staff agencies using a standardized interview technique (see Appendix B). The data collected during the field research stage was the input for the Stage II data analysis.

Data analysis using descriptive and nonparametric statistical techniques provided the information necessary to answer Research Questions 1 and 2. Descriptive statistics answered "where and how" airlift would support AirLand Battle operations. To answer Researcher Question 2, the researcher used the nonparametric Kendall coefficient of concordance (W), the Kendall tau method, the Wald-Wolfowitz technique, the multiple comparisons test, and a 90/75 percent criterion test specifically designed for the

research study. Stage II results provided the information for the researcher to develop a set of recommendations for MAC to consider for airlift operational and C-17 doctrines directly supporting AirLand Battle doctrine. The recommendations were then evaluated by the Military Airlift Command-Training and Doctrine Command Airlift Concepts and Requirements Agency (MAC-TRADOC ACRA). The validity of the researcher's recommendations and the Research Question 3 answer was therefore confirmed, and the research study's primary objective achieved.

This chapter presents the researcher's conclusions and recommendations for airlift operational and C-17 doctrines that support AirLand Battle doctrine. A general response to Research Questions 1 and 2 contains the researcher's general answer to each question. Immediately following each general response is a primary conclusion based specifically on the research findings directly related to a particular question. Corollary conclusions follow the primary conclusion for Research Question 2. The corollary conclusions are presented to assist the further understanding of the interrelationships between the airlift factors that could contribute to successful AirLand Battle operations. The researcher based the corollary conclusions on the primary, corollary, and tertiary findings. Additionally, the corollary conclusions provided further support for the researcher's recommendations which integrated all the information obtained from the data collected.

RESEARCH QUESTION No. 1

Are there significant differences between the Army and Air Force regarding the environmental, operational, and airlift factors that describe "where and how" airlift support could contribute the most to successful AirLand Battle operations?

General Response

No differences existed between the Army and Air Force sample subgroups regarding the factors used to describe "where and how" airlift support could contribute most to successful AirLand Battle operations.

Primary Conclusion

Based on Research Question 1's primary findings, the researcher concluded the Army and Air Force respondents had similiar views regarding air defense threats and theaters of operation, AirLand Battle operations requiring airlift support, and airlift missions that could contribute to successful AirLand

Battle operations. The researcher concluded airlift could contribute most to the support of AirLand Battle operations in a medium threat-contingency theater, primarily supporting close operations in a tactical role, and providing direct delivery, strategic deployment of Continental US (CONUS) forces to the employment area.

RESEARCH QUESTION No. 2

What airlift factors could most significantly influence the successful outcome of AirLand Battle operations?

General Response

The airlift factors identified by the 12 respondents as having the most significant positive influence on the successful outcome of AirLand Battle operations were 9 airlift requirements and 8 airlift capabilities.

The most significant airlift requirements were direct delivery of the assault echelon of CONUS airborne forces; direct delivery of a CONUS airborne brigade equivalent to augment previously employed forces; direct delivery of a CONUS light infantry brigade; direct delivery of a CONUS air assault brigade; intratheater single lift airdrop of an assault echelon of an airborne brigade 24 hours after the first aircraft lands; airlift sustainment of all light forces in close operations; airlift sustainment for all light forces in deep operations; airland or airdrop sustainment of petroleum, oil and lubricants (POL) and ammunition for light forces forward of division level; and airland or airdrop sustainment of POL and ammunition for light forces forward of brigade level.

Addressing the most significant airlift capabilities, the Army and Air Force subgroups indicated that performance of all airlift missions in both night and adverse weather conditions; regular performance of all airlift missions in a low to medium threat air defense environment; airland delivery of outsize cargo to small, austere airfields; intratheater force reemployment with a 6-hour response time; occasional performance of all airlift missions in a high threat environment; regular airdrop sustainment forward of division level by containerized delivery system; low level airdrop of forces and equipment; and airland delivery of bulk fuel with direct offload into vehicles could have the most positive influence on the successful outcome of AirLand Battle operations.

Primary Conclusions

The Army and Air Force respondents placed a high priority on the rapid deployment of small size CONUS based light forces. Additional concerns, evident in the respondents' selection of significant airlift requirements, were the importance of rapid, intratheater airlift of small size, light forces, and the need for airlift sustainment of light forces forward of division level in a theater lacking developed ground lines of communication.

Regarding airlift capabilities, the respondents' foremost priorities were consistent with their airlift requirements' priorities. The researcher concluded airlift aircraft must have both the strategic and tactical capability to move forces and equipment, including outsize, in a low to medium threat environment, to airfields typical of contingency theaters. Furthermore, all airlift missions will have to be performed both at night and in adverse weather.

COROLLARY CONCLUSIONS

The following section presents the researcher's corollary conclusions which provided a more comprehensive description of airlift support of AirLand Battle doctrine. The corollary conclusions resulted from the researcher's interpretation of all the study's findings.

First Corollary Conclusion

The findings revealed airlift support could contribute most to successful AirLand Battle operations in a medium threat - contingency theater. The findings indicated the respondents placed a high priority on airlift capability in a low to medium threat air defense environment as opposed to a high threat environment. The researcher concluded, not withstanding the Central European threat for which AirLand Battle doctrine was originally developed against, the Army and Air Force respondents recognized the greater importance of airlift support in world areas characterized by lesser developed ground lines of communication (Latin and South America, Africa, Southwest Asia). Additionally, the sample recognized the improved ability of airlift to successfully support AirLand Battle operations in less sophisticated and hostile air defense threats. Regardless of the overall and stated US priority to Western European defense, the researcher concluded airlift support of AirLand Battle operations could contribute most to successful AirLand Battle operations in Third World areas.

Second Corollary Conclusion

Consistent with the first corollary conclusion, the second corollary conclusion resulted from the respondents' selection of the airlift mission, AirLand Battle operation, and airlift requirements that could have the most influence on successful AirLand Battle doctrine execution. The researcher concluded, in world areas void of forward based US combat forces, the priority intertheater airlift mission could be direct delivery deployment of light forces to the employment area. Similarily, the primary intratheater airlift mission would be airlift sustainment of light forces engaged in close operations forward of division level.

Third Corollary Conclusion

Army and Air Force respondents indicated by their rankings the low significance of the requirements for strategic and tactical airlift of mechanized forces and airlift from theater Aerial Ports of Debarkation or Sea Ports of Debarkation (APOD/SPOD). However, when the researcher considered the respondents' Likert-type responses and associated comments, the researcher concluded intratheater airlift of mechanized forces, particularly from SPODs, could contribute to light force augmentation in Third World areas. Consequently, airlift aircraft must be capable of airland delivery of outsize cargo to small, austere airfields.

Fourth Corollary Conclusion

This conclusion resulted from the high priority the sample placed on the rapid deployment of CONUS based light forces directly to the employment area. The researcher concluded the effective deployment and employment of light forces, particularly air assault forces, could be highly dependent on the capability to airlift all Army outsize equipment intact; this would require a capability in addition to airlift of heavy forces' equipment. Furthermore, the researcher concluded airlift aircraft must have the capability for rapid, combat offload of outsize equipment accompanying light forces, to minimize aircraft exposure time in the employment area and maximize the combat effectiveness of direct delivered forces.

Fifth Corollary Conclusion

The bases for the fifth corollary conclusion were the respondents' selection of the close operation as requiring the most airlift support and comments regarding light forces' and

methods of airlift sustainment. The researcher concluded an important intratheater airlift mission could be routine delivery, at least to brigade level, of POL and ammunition to light forces in low threat-contingency theaters. Furthermore, the researcher concluded that low altitude extraction and containerized delivery were airlift delivery capabilities best suited for sustainment of light forces in close operations.

Sixth Corollary Conclusion

By the ranks assigned, the Army and Air Force subgroups indicated that strategic and tactical airlift of airborne forces could have the most significant influence on the outcome of AirLand Battle operations. Consequently, the researcher concluded that primary intertheater and intratheater airlift missions would be the airdrop of combat forces. Additionally, the researcher concluded that not only would strategic and tactical airlift aircraft have to be maneuverable and survivable at 300-500 feet altitude and 130 knots airspeed, but strategic and tactical airlift aircraft must be easily reconfigurable to perform airdrop missions. Furthermore, strategic and tactical doctrine must provide a basis for aircrews to be trained in airdrop missions and tactics to be developed and tested.

Seventh Corollary Conclusion

The seventh corollary conclusion addresses airlift aircraft survivability. Based on the respondents' comments, the researcher concluded aircraft must have onboard air defense countermeasures and aircrew protection in order to survive and support AirLand Battle operations.

Eighth Corollary Conclusion

Directly related to survivability is the eighth corollary conclusion. Based on the respondents' comments, the researcher concluded airlift aircraft must have communications equipment compatible with communications equipment used by US Army and Air Force forces involved with the Joint Suppression of Enemy Air Defenses (J-SEAD). Because of the importance of light forces' immediate sustainment and the need for airlift support of deep operations, the researcher concluded complete airspace superiority could not be established prior to airlift operations. Therefore, airlift aircraft must be able to communicate with US ground and air forces involved with establishing air superiority to improve the survivablity of airlift operations. Moreover, the researcher concluded airlift support could best be accomplished by using airlift corridors because of the ongoing suppression of

of the enemy air defense threat and the accompanying airspace "congestion and lethality."

Ninth Corollary Conclusion

The researcher concluded, from the airlift capabilities' rankings and related comments, the capability to perform all airlift missions, except flare drop, in all weather conditions and at night is significantly greater than any other capability supporting AirLand Battle operations. Addressing the exception, the researcher concluded that accomplishment of a flare drop mission by airlift aircraft could not contribute significantly to airlift support of AirLand Battle doctrine.

Tenth Corollary Conclusion

The researcher's last conclusion resulted from the subgroup's comments reported as tertiary findings, and the researcher's overall conclusion based on the previous nine corollary conclusions. The researcher concluded that any airlift doctrine developed to specifically support AirLand Battle doctrine must be adaptable and flexible to allow tailored application to differing global environments. The findings identified an operational environment and airlift factors needed to successfully provide airlift support for AirLand Battle operations. The findings further revealed the need for an airlift aircraft easily adaptable and strategically and tactically interchangeable to meet the full range of AirLand Battle doctrine's strategic and and tactical airlift requirements. Therefore, based on all the research findings, the researcher concluded the C-17 because of its designed adaptability to the intertheater and intratheater roles; direct delivery capability to small, austere airfields; and planned all weather and night capabilites is an aircraft capable of meeting all of AirLand Battle doctrine's intertheater and intratheater airlift requirements.

RECOMMENDATIONS

The primary research objective was development of recommendations for MAC to consider in the formulation of airlift operational and C-17 doctrines that support AirLand Battle doctrine. The researcher based the following recommendations on the primary and corollary conclusions presented in this chapter's preceeding section. The researcher's intent was to provide MAC with recommendations against which appropriate airlift manuals could be evaluated and, if needed, revised. In this manner, the researcher's recommendations could become a basis for the overall assessment and development of the best way for MAC fixed wing airlift to successfully support AirLand Battle doctrine.

Recommendation for Developing
Operational and C-17 Doctrine

Airlift operational and tactical doctrines, specifically C-17 doctrine, need to recognize the importance the Army and Air Force staff agencies placed on the requirement to rapidly project CONUS combat forces and their equipment directly into world areas with small, austere airfields and lesser developed ground lines of communication. Therefore, three actions need to be initiated. First, the Air Force, with considerable Army support, must develop an airlift operational doctrine that integrates AirLand Battle's inseparable strategic and tactical airlift demands. This Air Force 2-series manual should describe the best use of airlift forces in the context of distinct AirLand Battle airlift requirements and capabilities, operational environments, and airlift missions best suited to support AirLand Battle doctrine. Second, the Air Force, with complete Army support, must articulate through the budget process and to Congress why the C-17 is the one aircraft that best satisfies AirLand Battle's tactical airlift requirements and provides a rapid, strategic deployment capability for US ground forces. Third, the Air Force should apply airlift operational doctrine by describing the proper use of all MAC aircraft, particularly the C-17, to support AirLand Battle doctrine. The resultant airlift 3-series manuals should comprehensively address the diverse regional threats and theater types in describing how MAC aircraft can best support global AirLand Battle operations. This overall statement of airlift tactical doctrine should also address the integration and coordination anticipated to be required with J-SEAD efforts during AirLand Battle operations.

Recommendation for Airlift
Doctrine Consolidation

Air Force Manuals (AFMs) 2-4 and 2-21 require immediate review, updating, and consolidation. Dated 10 August 1966 and 13 July 1972 respectively, both manuals need to incorporate AirLand Battle's inseparable strategic and tactical airlift requirements. A starting point would be establishment of a single office of primary responsibility (OPR) for all MAC fixed wing airlift doctrines that support AirLand Battle doctrine. The researcher's recommendation is intended to dissolve the existing separation of intertheater and intratheater airlift responsibilites and missions that AirLand Battle operations require to be integrated.

The study revealed AirLand Battle would require direct delivery deployment of CONUS based forces and equipment to the employment area; airborne forces delivery being the foremost priority. The current AFM 2-4 recognizes that "tactical airlift forces are manned, equipped, and trained to perform airborne

operations for the delivery of combat forces directly into an objective [employment] area," and have the capability "to be committed to both deployment and employment operations to, within, and from areas of operation . . . at any level of conflict . . . as far forward in the combat zone as requirements demand" (7:1-3). But, while AFM 2-21 does provide for " . . . strategic airlift resources when directed to augment tactical airlift forces in the accomplishment of tactical airlift tasks," there are no strategic, operational doctrine provisions that address the study's identified airland or airdrop direct delivery requirements (8:2).

A common operational doctrine would promulgate to airlift skeptics the Services' joint recognition of the need to concurrently address the strategic and tactical airlift requirements and capabilities necessary to support AirLand Battle doctrine. At the same time, an integrated strategic and tactical 2-series manual under a single OPR would significantly improve the process for funding, equipping, and training MAC airlift components to perform the strategic and tactical airlift missions required to support AirLand Battle doctrine.

Recommendation for Doctrine Coordination

The researcher recommends the Air Force, MAC, Tactical Air Command, and the Army's Training and Doctrine Command coordinate and integrate J-SEAD doctrine and tactics with airlift doctrine and tactics. The exchange of operational, environmental, threat, airspace command and control, and battlefield management information is essential for airlift aircraft survivability and mission accomplishment. Such interservice and intraservice coordination and cooperation are vital to the successful support of AirLand Battle operations.

Recommendation for Survivability

The study revealed the need for ensuring airlift aircraft survivability to meet AirLand Battle's deployment, employment, sustainment, and across the Forward Line of Own Troops (FLOT) requirements. The researcher recommends three areas be considered. First, airlift tactical doctrine should contain an in-depth discussion of air defense threats to airlift aircraft and appropriate defensive tactics for particular airlift missions. Second, the Air Force must ensure, particularly for the C-17, appropriate defensive systems, specifically electronic countermeasures and cockpit armor protection, are built into the aircraft, so survivability tactics can be developed, practiced and evaluated. Third, since airlift missions might have to be performed without the benefit of air superiority, airlift

aircraft must have communications equipment common with J-SEAD forces. Initially, the C-17 will not have all of these capabilities because of fiscal limitations (12:6-7).

Recommendation for Weather and Night Airlift Doctrine

Airlift operational and tactical doctrines that support AirLand Battle doctrine must address the Army's intent to maximize adverse weather and night AirLand Battle operations. Lessons from previous and similiar airlift operations need to be developed into airlift doctrines that support AirLand Battle operations and exploit the Army's night fighting advantage. The researcher recommends that any doctrine revision be accompanied by the development of total night vision doctrine and tactics; inclusion of total night vision capability in the C-17, with field upgrades to other aircraft; and restriction of the flare drop mission to limited situations (e.g., rear operations in low threat environments or low intensity conflicts). Along with the doctrine and hardware there should be a program to expand the total night expertise among airlift crews.

Recommendation for Doctrine Test and Evaluation

The researcher recommends the Air Force, Army, and MAC jointly review airlift doctrines, consistent with AirLand Battle doctrine, execution during a rigorous field test program. The review should evaluate airlift aircrafts' and crews' ability to successfully execute the airlift doctrines specifically developed to support AirLand Battle doctrine. The researcher recommends that Red Flag, Green Flag, and National Training Center exercises be considered as possible testing environments. Furthermore, the C-17 should be evaluated to determine its ability to airland and airdrop the light and heavy forces the study identified as most significant. Additionally, the evaluation should encompass the night, weather, communications, and survivability requirements the study indicated are necessary to support AirLand Battle operations. The researcher recommends any test of airlift doctrines be fully integrated into a simulated J-SEAD effort to examine command, control, communications, and battlefield management.

Recommendation for Intratheater Logistics Operation

AFMs 2-4 and 2-21 lack substantive treatment of logistical airlift operations from SPODs. The researcher recommends that

airlift operational doctrine include a discussion of intratheater airlift of equipment and supplies offloaded at SPODs. The researcher's recommendation stems from the study's findings that revealed the low significance of intertheater airlift of heavy forces and equipment and supplies from SPODs, but recognized the need for the rapid intratheater movement of heavy forces. In contingency theaters with no US, forward based heavy forces, Air Force airlift could be required to tactically airlift mechanized forces from sea ports directly to the battlefield. Accordingly, not only will airlift's "ground network" have to be familiar with SPOD operations, but so will aircrews.

Recommendation for Air Force Airlift and Army Doctrines

Air Force airlift doctrines must be consistent with the requirements of AirLand Battle doctrine. Likewise, changes in the Army's doctrine must be immediately communicated to the Air Force to prevent unproductive and costly force restructure and hardware decisions by either Service. The researcher's final recommendation is that the Air Force and Army through the Airlift Concepts and Requirements Agency (ACRA) perform an annual review of AirLand Battle doctrine, the developing Army 21 concept, and supporting airlift doctrine. This review should identify specific Army airlift requiremens that could limit or negate existing or planned airlift capability. The review should also identify doctrine objectives and possible force restructures and equipment procurements for the following fiscal year and next five years.

FIELD EVALUATION

The feedback from the MAC-TRADOC ACRA "field experts" review indicated the recommendations were accurate within the context of the research design and had practical application. Specifically, the ACRA "experts'" review indicated that the recommendations for a combined strategic and tactical airlift operational doctrine; airlift doctrines that address air defense survivability; airlift doctrines that interface with J-SEAD doctrine; and a continuing joint review of airlift doctrines that support AirLand Battle doctrine were "good points." However, the review did emphasize that while the C-17 will have a positive effect, it is not an airlift cureall. Specifically, the C-17 is probably not the best aircraft to fulfill the continuing requirement for a dedicated intratheater airlift fleet that would primarily perform large numbers of small payload, short distance missions.

IMPLICATIONS OF THE RESEARCH

The researcher's investigation of airlift support of AirLand Battle was, to the researcher's knowledge, the first empirical study of the factors affecting the outcome of AirLand Battle operations. Consequently, the researcher created an initial data base that could be used for future research. More importantly, the researcher identified the environmental, operational, and airlift factors viewed by Army and Air Force staff agencies as having the most influence on the successful outcome of AirLand Battle doctrine execution. In the short term, the study's recommendations provide the Air Force and MAC with a set of guidelines against which current airlift doctrines can be evaluated to determine their compatibility with AirLand Battle's airlift requirements. Furthermore, several recommendations require long term, joint cooperation to monitor Army and Air Force doctrines and accompanying force or equipment changes to ensure the demands of Army doctrine and US force projection strategy are fulfilled.

RECOMMENDATIONS FOR FUTURE RESEARCH

The researcher recommends future research efforts concentrate on the following six issues:

1. A replication of this study should address the environmental, operational, and airlift factors affecting AirLand Battle operations from a theater perspective. The research should expand the number of respondents to include Army theater and corps commanders, MAC wing commanders, the Air Force Airlift Center, and US Central Command. The research should determine whether significant differences exist among the airlift requirements and capabilities needed to support AirLand Battle doctrine in Northeast and Southwest Asia, Africa, Latin and South America.

2. A classified study should examine theater air defense threats airlift aircrews could encounter while supporting AirLand Battle operations. The study should investigate the appropriate defensive systems, to include electronic countermeasures, airlift aircraft need to counter the most likely theater threats.

3. A cost-benefit analysis should focus on the inclusion of a nuclear, biological, and chemical and outsize airdrop capabilities in the C-17, versus the need to perfect a complete all weather and night capability.

4. A study should address fixed wing and rotary capabilities and assets within the context of a joint airlift strategy to

support AirLand Battle doctrine. The study should focus on determining the optimum mix of fixed wing and rotary assets, their command and control, and their integration on the battlefield to reduce mission redundancy between the Services.

5. A study should investigate the impact of the Army 21 concept on airlift support and existing and planned airlift aircraft.

6. Finally, a war game study of airlift support of AirLand Battle doctrine should concentrate on determining time-phased airlift requirements starting with a US decision to mobilize CONUS based forces.

FINAL OBSERVATIONS

This research study provided invaluable insight into the requirements, capabilities, and issues associated with fixed wing airlift support of AirLand Battle doctrine. The researcher acknowledges that the C-17 is not the only airlift aircraft that must be considered when evaluating the total airlift support of Army doctrine. Equally important will be the best use of C-130, C-141, C-5, and civilian aircraft to meet the full range of airlift demands. However, the researcher strongly believes that the strategic and tactical airlift requirements the study revealed as most significant can best be met by an aircraft with the C-17's planned capabilities.

Notwithstanding the study's findings regarding the factors that could most significantly impact the outcome of AirLand Battle operations, the research more importantly demonstrated the Army and Air Fore are consistent in their views regarding airlift support of Army doctrine. This indicates the Services are correctly oriented to successfully developing compatible ground and airlift forces that are capable of executing AirLand Battle doctrine and US force projection strategy.

APPENDICES

APPENDIX A

AIRLIFT REQUIREMENTS AND CAPABILITIES LISTING

The following is a listing of the 23 airlift requirements preceeded by the alpha identifier used throughout the study.

IDENTIFIER	REQUIREMENT
A	Direct delivery of a CONUS based brigade size light infantry force to within 20-30 kilometers (km) of the intended employment area.
B	Direct delivery of the assault echelon of a CONUS based airborne brigade to within 20-30 km of the intended employment area.
C	Direct delivery of a follow-on brigade equivalent of CONUS based airborne forces to augment a previously deployed assault echelon.
D	Direct delivery of a mechanized battalion to within 150-200 km of the intended employment area.
E	Direct delivery of a light infantry division to within 20-30 km of the intended employment area.
F	Direct delivery of a CONUS based brigade size air assault force to within 100 km of the intended employment area.
G	Direct delivery of a motorized infantry brigade to within 150-200 km of the intended employment area.
H	Direct delivery of a motorized infantry division to within 150-200 km of the intended employment area.
I	Single lift intratheater airdrop of an assault echelon of an airborne brigade within 24 hours after the first airlift aircraft lands for reemployment.
J	Following the intratheater airdrop of an assault echelon of an airborne brigade, the complete airland of a follow-on brigade equivalent to within 20-30 km of the assault echelon within 24 hours.

K	The complete intratheater airland movement of a mechanized battalion a maximum distance of 2000 km within 24 hours after the first airlift aircraft arrives.
L	The complete intratheater airland movement of a light infantry brigade a maximum distance of 2000 km in 24 hours.
M	The airland or airdrop of light forces in a deep attack operation up to a distance of 150 km beyond the FLOT.
N	Provide airlift sustainment for all light forces in close operations starting 48-72 hours after their employment.
O	Provide airlift sustainment for all light forces in deep operations starting 48-72 hours after their employment.
P	Provide airlift sustainment for all heavy forces in close operations starting 48-72 hours after their employment.
Q	Provide airlift sustainment for all heavy forces in deep operations starting 48-72 hours after their employment.
R	Airland or airdrop sustainment of POL and ammunition for light forces forward of the division level.
S	Airland or airdrop sustainment of POL and ammunition for light forces forward of the brigade level.
T	Airland or airdrop sustainment of POL and ammunition for heavy forces forward of the division level.
U	Airland or airdrop sustainment of POL and ammunition for heavy forces forward of the brigade level.
V	Airland or airdrop movement of prepositioned equipment and supplies from offload at APOD/SPOD to division level.
W	Conduct of flare drop to support close operations.

The following is a listing of the 10 airlift capabilities preceeded by their Roman numeral identifiers used throughout the study.

IDENTIFIER	CAPABILITY
I	Regular performance of all airlift missions in a low to medium threat environment.
II	Occasional performance of all airlift missions in a high threat environment.
III	Airland delivery of outsize cargo to small austere airfields.
IV	Regular operation in a nuclear, biological and chemical environment.
V	Regular airdrop sustainment forward of division level by containerized delivery system.
VI	Airland delivery of bulk fuel with offload directly into bladders or vehicles.
VII	Low level airdrop of combat forces, supplies, and equipment.
VIII	Airdrop of outsize cargo.
IX	Emergency reemployment with a response time of 6 hours or less from a brigade or higher commander's decision.
X	Performance of all airlift missions in both night and adverse weather conditions.

COMMENTS

APPENDIX B

INTERVIEW SCHEDULE

INTERVIEW SCHEDULE DEFINITIONS

LOW THREAT- An air defense threat characterized by small arms and light, optically aimed Anti Aircraft Artillery (AAA) up to .51 caliber.

MEDIUM THREAT- An air defense threat characterized by small arms, optically aimed AAA greater than .51 caliber, and man transportable, shoulder fired weapons. This threat may include more sophisticated air defense systems employed in a dispersed pattern making their avoidance possible with proper defensive equipment or tactics being employed.

HIGH THREAT- An air defense threat characterized by small arms, light optically aimed AAA heavier than .51 caliber, man transportable, shoulder fired weapons, and an airdefense network that poses a high probability of detection and aircraft attrition unless suitable aircraft defensive systems or evasive tactics are immediately employed.

CONTINGENCY THEATER- A world area characterized by a medium or less air defense threat, no US theater based forces, limited host nation support, limited ground lines of communication, extended employment distances, and a predominance of small, austere airfields. Africa and Latin America would be contingency theaters, while Southwest Asia though being at the,upper end of the air defense threat spectrum does have all other characteristics of a contingency theater.

MATURE THEATER- A world area characterized by a medium to high air defense threat, US theater based forces, significant host nation support, and well developed lines of communication.

LINES of COMMUNICATION- Ground, air, or sea routes to and within a country, region, or theater.

SMALL, AUSTERE AIRFIELDS- An airfield that is at best 3,000 feet long by 90 feet wide and lacking one or a combination of hard surface runways and taxiways, parking aprons, airfield lighting, navigational aids, or adequate material handling equipment to offload US military cargo aircraft.

DIRECT DELIVERY- US airlift of military forces, equipment, or supplies from the Continental United States (CONUS) to small austere airfields within a combat theater, without any enroute stops for fuel or offload to another US airlift aircraft.

POL- Petroleum, oil, and lubricants required by US combat forces to fulfill their combat roles.

SUSTAINMENT- Providing and maintaining the minimum levels of replacement combat forces, combat support forces, ammunition, spare parts, POL, rations, and water to permit US combat forces to fulfill their combat roles.

FLOT- Forward Line of Own Troops as used in the discussion of the US Army's AirLand Battle doctrine.

LIGHT FORCES- US infantry, airborne, air assault, or motorized infantry forces. Except for helicopters, light forces' equipment is not outsize cargo.

HEAVY FORCES- US armored and mechanized combat units. Equipment such as tanks and armored personnel carriers are outsize cargo.

OUTSIZE CARGO- Cargo that normally exceeds 1090 inches long by 117 inches wide by 105 inches high, and is qualified as outsize cargo by the aircraft air dimension code assigned under Military Standard Transportation and Movement Procedures. Current outsize cargo airlift capability is limited to the C-5 aircraft, and is a planned capability for the C-17 aircraft.

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AIRLIFT SUPPORT OF AIRLAND BATTLE INTERVIEW

SECTION I

INTERVIEWEE'S NAME:

INTERVIEWEE'S JOB TITLE:

NUMBER OF YEARS MILITARY EXPERIENCE:

NUMBER OF YEARS IN CURRENT JOB:

NUMBER OF YEARS EXPERIENCE WITH AIRLAND BATTLE DOCTRINE:

NUMBER OF YEARS EXPERIENCE WITH AF AIRLIFT:

NUMBER OF YEARS JOINT EXPERIENCE (ARMY/AF):

DATE OF INTERVIEW:

DIRECTIONS FOR SECTION II

Please respond as accurately as possible. Respond to the following items according to the following example.

Response to Circle	Definition
1	If you strongly disagree with the statement
2	If you disagree with the statement
3	If you are uncertain about the statement
4	If you agree with the statement
5	If you strongly agree with the statement

EXAMPLE: If you are uncertain about a statement completely circle the number 3.

STRONGLY DISAGREE	DISAGREE	UNCERTAIN	AGREE	STRONGLY AGREE
1	2	(3)	4	5

SECTION II

To what extent do you agree that the following Airland Battle airlift requirements would positively influence the successful conduct of combat operations in a medium threat contingency theater.

Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
1	2	3	4	5

Direct delivery of a CONUS based brigade size light infantry force, to within 20-30 km of the intended employment area.	1	2	3	4	5
Direct delivery of the assault echelon of a CONUS based airborne brigade to within 20-30 km of the intended employment area.	1	2	3	4	5
Direct delivery of a follow-on brigade equivalent of CONUS based airborne forces to augment a previously deployed assault echelon.	1	2	3	4	5
Direct delivery of a mechanized battalion to within 150-200 km of the intended employment area to augment light forces.	1	2	3	4	5
Direct delivery of a light infantry division to within 20-30 km of the intended employment area.	1	2	3	4	5
Direct delivery of a CONUS based brigade size air assault force to within 100 km of the intended employment area.	1	2	3	4	5
Direct delivery of a motorized infantry brigade to within 150-200 km of the intended employment area.	1	2	3	4	5
Direct delivery of a motorized infantry division to within 150-200 km of the intended employment area.	1	2	3	4	5
Single lift intratheater airdrop of an assault echelon of an airborne brigade within 24 hours after the first airlift aircraft lands for reemployment.	1	2	3	4	5

Following the intratheater airdrop of an assault echelon of an airborne brigade, the complete airland of a follow-on brigade equivalent to within 20-30 km of the assault echelon within 24 hours.	1	2	3	4	5
The complete intratheater airland movement of a mechanized battalion a maximum distance of 2000 km within 24 hours of the first airlift aircraft arriving.	1	2	3	4	5
The complete intratheater airland movement of a light infantry brigade a maximum distance of 2000 km in 24 hours.	1	2	3	4	5
The airland or airdrop of light forces in a deep attack operation up to a distance of 150 km beyond the FLOT.	1	2	3	4	5
Provide airlift sustainment for all light forces in close operations starting 48-72 hours after their employment.	1	2	3	4	5
Provide airlift sustainment for all light forces in deep operations starting 48-72 hours after their employment.	1	2	3	4	5
Provide airlift sustainment for all heavy forces in close operations starting 48-72 hours after their employment.	1	2	3	4	5
Provide airlift sustainment for all heavy forces in deep operations starting 48-72 hours after their employment.	1	2	3	4	5
Airland or airdrop sustainment of POL and ammunition for light forces forward of the division level.	1	2	3	4	5
Airland or airdrop sustainment of POL and ammunition for light forces forward of the brigade level.	1	2	3	4	5
Airland or airdrop sustainment of POL and ammunition for heavy forces forward of the division level.	1	2	3	4	5

Airland or airdrop sustainment of POL and ammunition for heavy forces forward of the brigade level.	1	2	3	4	5
Airland or airdrop movement of prepositioned equipment and supplies from offload at APOD/SPOD to division level.	1	2	3	4	5
Conduct of flare drop operations in support of close operations.	1	2	3	4	5

COMMENTS

SECTION III

The following airlift requirements supporting Airland Battle combat operations when considered independently could positively influence the successful outcome. Rank the requirements from most significant influence (ranking of 1) to least significant influence (ranking of 23).

REQUIREMENT	RANK
Direct delivery of a CONUS based brigade size light infantry force, to within 20-30 km of the intended employment area.	
Direct delivery of the assault echelon of a CONUS based airborne brigade to within 20-30 km of the intended employment area.	
Direct delivery of a follow-on brigade equivalent of CONUS based airborne forces to augment a previously deployed assault echelon.	
Direct delivery of a mechanized battalion to within 150-200 km of the intended employment area to augment light forces.	
Direct delivery of a light infantry division to within 20-30 km of the intended employment area.	
Direct delivery of a CONUS based brigade size air assault force to within 100 km of the intended employment area.	
Direct delivery of a motorized infantry brigade to within 150-200 km of the intended employment area.	
Direct delivery of a motorized infantry division to within 150-200 km of the intended employment area.	
Single lift intratheater airdrop of an assault echelon of an airborne brigade within 24 hours after the first airlift aircraft lands for redeployment.	
Following the intratheater airdrop of an assault echelon of an airborne brigade, the complete airland of a	

follow-on brigade equivalent to within 20-30 km of the assault echelon within 24 hours.

The complete intratheater airland movement of a mechanized battalion a maximum distance of 2000 km within 24 hours of the first airlift aircraft arriving.

The complete intratheater airland movement of a light infantry brigade a maximum distance of 2000 km in 24 hours.

The airland or airdrop of light forces in a deep attack operation up to a distance of 150 km beyond the FLOT.

Provide airlift sustainment for all light forces in close operations starting 48-72 hours after their employment.

Provide airlift sustainment for all light forces in deep operations starting 48-72 hours after their employment.

Provide airlift sustainment for all heavy forces in close operations starting 48-72 hours after their employment.

Provide airlift sustainment for all heavy forces in deep operations starting 48-72 hours after their employment.

Airland or airdrop sustainment of POL and ammunition for light forces forward of the division level.

Airland or airdrop sustainment of POL and ammunition for light forces forward of the brigade level.

Airland or airdrop sustainment of POL and ammunition for heavy forces forward of the division level.

Airland or airdrop sustainment of POL and ammunition for heavy forces forward of the brigade level.

REQUIREMENT	RANK
Airland or airdrop movement of prepositioned equipment and supplies from offload at APOD/SPOD to division level.	
Conduct of flare drop operations in support of close operations.	

COMMENTS

SECTION IV

1. Given that AirLand Battle doctrine was initially developed to counter the Soviet-Warsaw Pact threat to Western Europe, but has now been adopted by the US army for global aplication, in which of the following areas would support of AirLand Battle require the most airlift contribution?

a. medium threat, mature theater

b. medium threat, contingency theater

c. high threat, mature theater

d. medium to high threat, contingency theater

e. low threat, contingency theater

2. Based upon the answer to question 1 above, which AirLand Battle operation would require the most airlift contribution?

a. Close operation

b. Deep operation

c. Rear operation

3. Based on the answers to questions 1 and 2 above, which airlift mission would contribute most to successful combat operations?

a. direct delivery deployment from CONUS

b. intratheater deployment from a theater APOD

c. intratheater sustainment

d. intratheater aeromedical evacuation

e. intratheater employment/redeployment

f. intratheater special operations

4. Rank order the following 10 airlift capabilities based on their independent, significant contribution (most significant rank of 1 to least significant rank of 10) to successful AirLand Battle combat operations.

CAPABILITY	RANK
Regular performance of all airlift missions in a low to medium threat environment.	
Occasional performance of all airlift missions in a high threat environment.	
Airland delivery of outsize cargo to small, austere airfields.	
Regular operation in a nuclear, biological, and chemical environment.	
Regular airdrop sustainment forward of division level primarily by containerized delivery system.	
Airland delivery of bulk fuel and offload directly into bladders or vehicles. Indicate to division or forward of division level.	
Low level airdrop of combat forces, supplies, and equipment. Indicate minimum altitude and optimum airspeed to maximize airdrop effectiveness.	
Airdrop outsize cargo. Indicate to division or forward of division level and type(s) of equipment.	
Emergency redeployment with a response time of 6 hours or less from a brigade or higher commander's decision. Indicate brigade or division.	
Performance of all airlift missions in both night and adverse weather conditions.	

COMMENTS

APPENDIX C

KENDALL COEFFICIENT OF CONCORDANCE

DATA AND ANALYSIS FOR AIRLIFT REQUIREMENTS AND CAPABILITIES

The researcher used the Kendall coefficient of concordance (W) test to determine whether agreement existed among the sample's 12 respondents' rankings and each of the 6 respondents within the 2 sample subgroups. The researcher analyzed both the 23 airlift requirements and the 10 airlift capabilities using the Kendall method. The hypotheses, procedures, interpretation rules, and analyses results follow (2:300-309; 6:229-239):

Null Hypothesis (H_0): There was no association among the rankings of the airlift requirements or capabilities.

Alternate Hypothesis (H_a): There was direct association among the rankings of the airlift factors (requirements or capabilities as applicable).

Significance Level: A researcher selects the significance level based upon the research's importance. Furthermore, the researcher when reporting findings should indicate the actual probability associated with the findings, thereby allowing the reader to apply personal judgement in deciding whether or not the null hypothesis should or should not be rejected. Therefore, after considering the practical significance of the research and the consequences of rejecting the null hypothesis improperly, the researcher established .10 as the level of significance and reported the actual probability.

Calculating W: The ordinal data consisting of "K" respondents' rankings of "N" airlift factors were arranged in a table with K rows and N columns. For the analysis of the sample this meant K=12 and for each subgroup K=6. Likewise, for the analysis of the airlift requirements N=23 and for the airlift capabilities N=10. The specific computational steps were:

Determine R_j, the sum of the ranks assigned to each airlift factor by each respondent.

Compute the mean of the R_j values, and for each airlift factor calculate the deviation between each factor's R_j value and the mean of the R_j's. Square the deviations and sum the squares to obtain a value referred to as "s."

Compute the value of W using the formula

$$W = \frac{12\ s}{K^2 \times (N^3 - N)}$$

Test Statistic: The significance of the computed W value was tested to determine the probability associated with the occurrence, with a true null hypothesis, of a value as large as

the "s" value associated with H_o. For large samples (N larger than 7), the researcher used the test statistic Q and the chi-square probability distribution to determine the probability associated with the occurrence of H_o of a value as large as the computed value. The test statistic Q was computed using the formula:

$$Q = K \times (N - 1)W$$

The distribution of Q being approximated by the chi-square distribution with N - 1 degrees of freedom.

Decision Rule: The researcher determined the probability of occurrence associated with the value of the test statistic Q, for N - 1 degrees of freedom; the same as the probability associated with occurrence of a "s" value under a true null hypothesis. The researcher then compared the probability associated with Q against the established .10 significance level. If the probability associated with Q was equal to or less than .10, then the researcher rejected the null hypothesis. If the probability associated with Q was greater than .10, then the researcher concluded that the data did not provide sufficient evidence to reject H_o.

Interpretation: If the null hypothesis was rejected, then the occurrence of no agreement (association) among the respondents' rankings was only very rarely by chance. Hence, the researcher intrepretated rejection of H_o as meaning the respondents did agree on the relative ordering of the airlift factors.

Special Application: Kendall suggests that the best estimate of the preferred ordering of N objects is provided, when the W value is determined significant, by the order of the sums of the ranks, R_j. The lowest R_j value associated with the airlift factor receiving the highest ranking. Consequently, the researcher arranged the R_j values in increasing numerical order to determine the respondents' preferential ordering.

Data and Calculations: Pertinent data and the calculations of the W value, Q value, and associated chi-square probability for the airlift factors are presented on the following pages.

"N"	"K" RANKINGS BY SUBGROUP AND RESPONDENT ARMY SUBGROUP						AIR FORCE SUBGROUP					
Requirements	1	2	3	4	5	6	7	8	9	10	11	12
A	17	5	15	7.5	15	1	1	10	6	5	7	3
B	16	1	16	1.5	14	2	2	8	7	3	8	10
C	3	2	17	3.5	16	4	12	9	8	4	1	5
D	21	12	8	13.5	21	22	5	17	5	15	6	12
E	15	17	18	9.5	19	3	13	16	2	1	5	1
F	1	11	23	9.5	17	5	3	15	3	16	2	2
G	11	22	4	13.5	18	10	4	19	4	13	3	21
H	13	23	5	15	22	11	14	21	1	14	4	13
I	2	3	19	1.5	10	9	6	3	12	10	15	18
J	22	4	20	3.5	11	11	7	4	14	11	16	11
K	8	13	3	19	20	21	8	6	13	17	14	17
L	10	14	14	14	12	14	9	5	11	12	17	15
M	23	7	22	5	13	23	19	1	15	8	21	16
N	7	6	6	18	6	6	10	7	10	2	19	6
O	6	8	7	7.5	7	16	20	2	17	9	20	4
P	18	18	1	20	8	19	11	23	9	18	11	22
Q	14	19	9	6	9	20	21	13	16	22	9	14
R	5	9	2	12	1	7	15	12	20	20	18	7
S	4	15	10	11	2	8	16	11	22	6	17	8
T	20	20	13	22	3	17	17	22	19	21	13	20
U	19	21	21	22.5	4	18	18	18	21	19	12	19
V	12	10	10	21	5	15	22	14	18	7	22	9
W	9	16	12	22.5	23	13	23	20	23	23	23	23

Table 9. Kendall Concordance Data, 23 Requirements.

"N" Requirements	COLUMN SUMS, R_j ARMY SUBGROUP	AIR FORCE SUBGROUP	SAMPLE
A	60.5	32	92.5
B	50.5	38	88.5
C	44.5	39	84.5
D	97.5	60	157.5
E	81.5	38	119.5
F	76.5	41	117.5
G	78.5	64	142.5
H	90	67	157
I	44.5	64	108.5
J	71.5	63	134.5
K	83	75	158
L	80	69	149
M	93	80	173
N	48	54	102
Ø	51.5	72	123.5
P	83	94	177
Q	77	95	172
R	36	92	128
S	50	73	123
T	84	112	196
U	105.5	107	212.5
V	73	92	165
W	95.5	135	230.5

Table 10. Kendall Concordance Column Sums, 23 Requirements.

Kendall Values	ARMY SUBGROUP	AIR FORCE SUBGROUP	TOTAL SAMPLE
R_j Mean	72	72	144
"s" value	8,548	15,489	33,415
W value	.23419	.42434	.22886
Q value	30.91	56.01	60.42
Probability	.09673	.00008	.00002

Table 11. Kendall Concordance Values, 23 Requirements.

"N" Requirements	OVERALL RANKINGS ARMY SUBGROUP	AIR FORCE SUBGROUP	SAMPLE
A	8	1	3
B	6	2	2
C	3	4	1
D	22	7	15
E	15	2	7
F	11	5	6
G	13	9	12
H	19	11	14
I	2	9	5
J	9	8	11
K	16.5	15	16
L	14	12	13
M	20	16	19
N	4	6	4
Ø	7	13	9
P	16.5	19	20
Q	12	20	18
R	1	17.5	10
S	5	14	8
T	18	22	21
U	23	21	22
V	10	17.5	17
W	21	23	23

Table 12. Overall Ranking of the 23 Airlift Requirements.

"N"	"K" RANKINGS BY SUBGROUP AND RESPONDENT											
	ARMY SUBGROUP							AIR FORCE SUBGROUP				
Capabilities	1	2	3	4	5	6	7	8	9	10	11	12
I	5	1	5.5	3	2	10	1	2	2	1	10	2
II	9	5	7	10	2	10	2	9	3	8	2	4
III	2	3	2.5	8	8	6.5	5	5	5	7	1	3
IV	8	10	2.5	10	6	9	10	8	10	10	3	10
V	3	7	8	2	5	2	8	4	6	2	6	7
VI	6	8	2.5	4.5	7	3	7	7	7	6	5	5
VII	4	9	8	1	9	5	6	6	4	3	4	6
VIII	10	6	8	9	10	6.5	9	10	8	9	7	8
IX	7	2	5.5	4.5	4	1	3	1	9	5	9	9
X	1	4	2.5	6	2	4	4	3	1	4	8	1

Table 13. Kendall Concordance Data, 10 Capabilities

"N" Capabilities	COLUMN SUMS, R_i ARMY SUBGROUP	AIR FORCE SUBGROUP	SAMPLE
I	26.5	18	44.5
II	41	28	69
III	30	26	56
IV	45.5	51	96.5
V	27	33	60
VI	31	37	68
VII	36	29	65
VIII	49.5	51	100.5
IX	24	36	60
X	19.5	21	40.5

Table 14. Kendall Concordance Column Sums, 10 Capabilities.

Kendall Values	ARMY SUBGROUP	AIR FORCE SUBGROUP	TOTAL SAMPLE
R_j Mean	33	33	66
"s" value	856	1,078	3,419
W value	.28822	.36296	.28779
Q value	15.56	19.60	31.08
Probability	.07657	.02055	.00028

Table 15. Kendall Concordance Values, 10 Capabilities.

"N" Capabilities	OVERALL RANKINGS ARMY SUBGROUP	AIR FORCE SUBGROUP	SAMPLE
I	3	1	2
II	8	4	8
III	5	3	3
IV	[illegible]	9	9
V	4	6	4.5
VI	6	8	7
VII	7	5	6
VIII	10	9	10
IX	2	7	4.5
X	1	2	1

Table 16. Overall Ranking of the 10 Airlift Capabilities.

APPENDIX D

90/75 PERCENT CRITERION TEST

DATA AND ANALYSIS FOR AIRLIFT REQUIREMENTS

The researcher applied the 90/75 percent criterion test to the 12 respondents' Likert-type responses (strongly disagree, disagree, uncertain, agree, or strongly agree) concerning the positive influence each of the 23 airlift requirements could have on the successful outcome of AirLand Battle operations in a medium threat-contingency theater. The criterion test permitted the researcher to determine a degree of consensus among the sample's rankings, and identified the requirements with the most positive influence on the successful outcome of AirLand Battle operations.

The researcher considered the test statistically valid since the Likert-type data analyzed were on an ordinal scale, and the test measured the frequency of agreement responses.

The researcher applied two prioritized decision rules while performing the test.

If 90 percent or more of the responses in either the Army or Air Force subgroup were strongly agree for a particular airlift requirement and 75 percent of the sample's total responses were strongly agree, then the requirement was a most positive influence else;

If less than 90 percent of the responses in either subgroup were strongly agree, then the agree and strongly agree responses within each subgroup were combined into an overall "agree" category. The 90 percent rule within either subgroup and 75 percent among the total sample was then applied to the total number of "agree" responses.

The Likert-type data and identification of the most positive influencing airlift requirements (annotated by an asterisk) among the sample are presented on the following pages.

"N"	DEGREE OF AGREEMENT BY SUBGROUP AND RESPONDENT ARMY SUBGROUP						AIR FORCE SUBGROUP					
Requirements	1	2	3	4	5	6	7	8	9	10	11	12
A	2	5	2	4	4	5	5	5	5	4	4	5
B	2	5	3	5	4	5	5	4	5	5	4	3
C	5	5	2	4	4	5	4	5	5	4	4	4
D	1	4	4	5	4	4	4	4	5	4	2	5
E	2	3	2	5	3	5	4	5	5	5	4	5
F	5	4	3	5	4	2	5	5	5	3	5	5
G	3	3	4	5	4	4	4	5	5	4	2	3
H	3	3	3	5	3	4	4	4	5	4	3	3
I	5	5	4	5	5	4	5	4	4	3	3	2
J	1	5	3	5	5	3	5	4	4	3	4	5
K	4	4	4	5	4	3	4	4	5	5	2	2
L	4	4	2	5	5	3	4	3	5	3	2	1
M	1	5	2	5	4	2	3	5	3	4	2	5
N	5	5	4	5	5	3	4	2	4	5	4	2
Ø	5	5	4	5	4	3	4	4	4	4	4	5
P	2	3	5	5	4	4	4	2	4	5	5	1
Q	3	3	5	5	4	3	4	3	5	2	4	5
R	5	5	4	5	5	4	4	4	3	3	4	1
S	5	4	5	5	5	4	4	2	3	4	4	1
T	1	3	4	5	5	3	4	3	3	4	4	1
U	2	3	4	5	5	4	4	2	3	5	4	1
V	3	5	3	5	5	4	4	5	5	4	3	4
W	4	4	3	2	2	4	3	3	3	1	3	1

Table 17. 90/75 Percent Likert-type Data for 23 Requirements.

"N" Requirements	TOTAL NUMBER OF RESPONDENTS IN AGREEMENT ARMY SUBGROUP	AIR FORCE SUBGROUP	SAMPLE
A*	4	6	10
B*	4	5	9
C*	5	6	11
D*	5	5	10
E	2	6	8
F*	4	5	9
G	4	4	8
H	2	4	6
I*	6	3	9
J	3	5	8
K*	5	4	9
L	4	2	6
M	3	3	6
N*	5	4	9
Ø*	5	6	11
P	4	4	8
Q	3	4	7
R*	6	3	9
S*	6	3	9
T	3	3	6
U	4	3	7
V*	4	5	9
W	3	Ø	3

Table 18. Agreement on a Requirement's Positive Influence.

APPENDIX E

THE MULTIPLE COMPARISONS TEST

DATA AND CALCULATIONS

Gibbons explains that when all possible differences between the column sums (R_j) of ranked objects are considered, the probability is at least 1-level of significance that the following inequality is satisfied for R_i, R_j pairs being evaluated (2:182).

$$\left| R_i - R_j \right| < z\sqrt{\frac{K\ (N+1)}{6}}$$

Where K is equal to the total number of respondents (12) and N is equal to the number of objects being analyzed. The z value coresponds to the right tail probability computed as the level of significance/N(N-1).

The researcher applied the multiple comparisons test to both the airlift requirements and capabilities to determine if there were any significant differences between the rankings of the airlift factors. In this manner, the researcher determined the airlift factors that would have the "most significant" positive influence on the outcome of AirLand Battle operations. The data for the test consisted of the 12 airlift requirements "agreed" to by the sample as having the most positive influence on AirLand Battle operations and all of the 10 airlift capabilities. Test procedures follow (2:182-187,313-314):

The researcher arranged the airlift requirements and capabilities column sums in increasing numerical order. The highest ranked factor, that with the most significance, was first among either the 12 requirements or 10 capabilities.

Since the test involved multiple comparisons not single comparisons as performed under all other statistical tests, the rearcher established the significance level at .20. The researcher computed the right-hand side of the aforementioned inequality, yielding values for the right tail probability, associated z value, and overall inequality value as .0015, 2.97, 15.14; and .002, 2.85, 13.37 for airlift requirements (N=12) and capabilities (N=10) respectively.

The researcher evaluated each pair of airlift requirements and capabilities, starting with a comparison between the most significant factor and the remaining factors and continuing for each successively less significant factor. Thus, the multiple comparisons produced an indication of which airlift factors were considered by the sample to be significantly less influential when compared against the airlift factor considered to have the most significant positive influence. Significant difference occurred when the difference between pairs of column sums (R_js) was greater than the right-hand side value of the inequality.

Tables 19 and 20 on the following pages contain the data and indications of which airlift requirements and capabilities were significantly less influential than the airlift factors identified by the sample as having the most significant positive influence on the outcome of AirLand Battle operations.

Requirements	Rank	R_i	Less significant requirements
C	1	84.5	D, F, I, K, N, O, R, S, V
B	2	88.5	D, F, I, K, O, R, S, V
A	3	92.5	D, F, I, K, O, R, S, V
N	4	102	D, F, K, O, R, S, V
I	5	108.5	D, K, R, V
F	6	117.5	D, K, V
S	8	123	D, K, V
O	9	123 5	D, K, V
R	10	128	D, K, V
D	15	157.5	
K	16	158	
V	17	165	

Table 19. Multiple Comparisons Data, 23 Requirements.

Capabilties	Rank	R_i	Less significant capabilities
X	1	40.5	II, IV, V, VI, VII, VIII, IX
I	2	44.5	II, IV, V, VI, VII, VIII, IX
III	3	56	IV, VIII,
V	4.5	60	IV, VIII,
IX	4.5	60	IV, VIII,
VII	6	65	IV, VIII,
VI	7	68	IV, VIII,
II	8	69	IV, VIII,
IV	9	96.5	
VIII	10	100.5	

Table 20. Multiple Comparisons Data, 10 Capabilties.

APPENDIX F

KENDALL TAU COEFFICIENT

DATA AND ANALYSIS

The Kendall Tau test was an appropriate statistical test to determine the degree of association (agreement) between the two sets of rankings for the airlift requirements and airlift capabilities (6:212). Specifically, the researcher measured the degree of agreement between the Army and Air Force subgroups' overall rankings of the airlift factors under study. The following paragraphs contain the hypotheses, procedures, interpretation rules, and data (2:284-291,420; 6:212-219).

Null Hypothesis (H_0): The Army and Air Force subgroups' overall rankings of the airlift factors (requirements and capabilites) were not associated.

Alternate Hypothesis (H_a): The two subgroups' overall rankings were in agreement.

Significance Level: As previously discussed in Appendix C, the researcher established .10 as the level of significance.

Kendall Tau Calculations: The Kendall Tau test determined how many pairs of Air Force ranks for the airlift factors were in their proper (natural) order, given the Army subgroup's overall ranking was arranged in natural order. Accordingly, the researcher arranged the airlift requirements (A through W) and capabilites (I through X) in an order corresponding to the Army subgroup's overall ordering of the factors. The researcher then arranged the Air Force subgroup's numerical ranks to correspond to the order of the requirements or capabilities as determined by the Army subgroup's ranking. Starting with the first Air Force rank, the researcher compared each following rank to determine which pairs of ranks were in their natural order. The researcher assigned a score of +1 for each pair of ranks properly ordered within the Air Force subgroup and a score of -1 for each pair of ranks not in their natural order. The researcher totaled the plus and minus scores to yield a value annotated as "s."

Test Statistic: The Kendall Tau coefficient T, was computed differently according to the number of airlift factors being analyzed. For large samples (N greater than 10) applicable to the 23 airlift requirements, T was approximated by the normal distribution and expressed as a z value according to the formula:

$$z = \frac{S}{\sqrt{N(N-1)(2N+5)/18}}$$

For small samples (N less than or equal to 10) applicable to the 10 airlift capabilities, the T value was computed according to the formula:

$$T = \frac{2s}{N(N-1)}$$

Interpretation Rules: For the large sample test statistic approximated by the z value, the researcher computed a normal distribution probability associated with the computed z value and compared the probability against the significance level. If the normal distribution probability was less than or equal to .10 then the researcher rejected H_o, meaning the two subgroups were in agreement on the overall ranking of the 23 airlift requirements. For the small sample, the researcher obtained an associated probability of occurrence under a true null hypothesis from an established table of Kendall Tau coefficient probabilities. The researcher then applied the same decision rule as with the large sample for deciding whether to reject H_o.

Data and Calculations: Tables 21 and 22 on the following pages contain the pertinent data and calculations.

Requirements	Army Ranking	Air Force Ranking
R	1	17.5
I	2	9
C	3	4
N	4	6
S	5	14
B	6	2.5
O	7	13
A	8	1
J	9	8
V	10	17.5
F	11	5
Q	12	20
G	13	[illegible]
L	14	12
E	15	2.5
K	16	15
P	17	19
T	18	22
H	19	11
M	20	16
W	21	23
D	22	7
U	23	21

S=(5-14)+(12-7)+(17-2)+(15-3)+(8-9)+(15-1)+(8-8)+(15-0)+(11-3)+(5-8)+(11-1)+(3-8)+(8-2)+(6-3)+(8-0)+(5-2)+(3-3)+(1-4)+(3-1)+(2-1)+(0-2)

S= 80

z = 2.11; associated probability = .01743

Table 21. Kendall Tau For Large Sample, 23 Requirements.

Capabilities	I	II	III	IV	V	VI	VII	VIII	IX	X
Army Rank	1	2	3	4	5	6	7	8	9	10
Air Force Rank	2	7	1	6	3	8	5	4	9.5	9.5

S = (8-1)+(3-5)+(7-0)+(3-3)+(5-0)+(2-2)+(2-0)
S = 20
T = .444; associated probability (.054 (exact value not given)

Table 22. Kendall Tau For Small Sample, 10 Capabilities.

APPENDIX G

WALD-WOLFOWITZ TEST

DATA AND ANALYSIS

The Wald-Wolfowitz test was well suited for determining whether two independent random samples differed in any respect; therefore, indicating the two samples were from different populations (6:136). Thus, the test provided a suitable technique to determine if the Army and Air Force subgroups were drawn from the same population. The hypotheses, procedures, intrepretation rules, and data follow (6:136-144):

Null Hypothesis (H_0): The Army and Air Force subgroups being two independent random samples were from the same population.

Alternate Hypothesis (H_a): The two subgroups differed in some manner, meaning they were not from the same population.

Significance Level: As discussed in Appendix C, the researcher established .10 as the significance level.

Wald-Wolfowitz Calculations: To apply the test to the ordinal data resulting from the two subgroups' rankings of the airlift factors, the researcher cast the combined column sums (R_js), for both subgroups in increasing numerical order. The test examined the sequence of R_j values to determine whether the values were well mixed. The underlying rationale was if the two subgroups were from the same population then the number of sequences of either Army or Air Force consecutive column sum values would be large. If the number of sequences of values were small, then the two populations must differ in some manner, thereby causing the distinct "grouping" of R_js. Consequently, the researcher counted the number of sequences of column sums applicable to each subgroup and identified the total count as "r."

Test Statistic: For large samples (N greater than 20 in either group), the test statistic was approximated by the normal distribution and calculated according to the formula:

$$z = \frac{\left| r - (2n_1n_2/n_1+n_2 + 1) \right| - .5}{\sqrt{2n_1n_2(2n_1n_2-n_1-n_2)/(n_1+n_2)^2(n_1+n_2-1)}}$$

Where n_1 and n_2 were both equal to 23, the number of requirements, and a correction for continuity (.5) was used.

For the small sample applicable to the airlift capabilities, the researcher was only able to obtain a critical r value corresponding to the .05 significance level from established Wald-Wolfowitz tables. However, the researcher considered the critical r value valid, since this tabulated value corresponded to a significance level more stringent than the established .10.

Interpretation Rules: For the large sample, the researcher compared the probability associated with the computed z value against the established significance level. If the z value's probability was greater than .10, then the data did not provide sufficient evidence for the researcher to reject the null hypothesis. Otherwise, if the z value's probability was less than or equal to .10, the reseacher rejected the null hypothesis, meaning the two subgroups were not from the same population. For the small sample, the researcher compared the computed r value against the critical r value. If the computed r value was greater than the critical value, H_o could not be rejected.

Data and Calculations: The relevant Wald-Wolfowitz information follows in Tables 23 and 24.

R_j Values	32	36	38	38	39	41	44.5	45.5	48	50	50.5	51.5	54	60	60.5	
Subgroup	AF	AR	AF	AR	AF	AF	AR	AR	AR	AR	AR	AR	AF	AF	AR	
Sequences	1	2	3	4	5			6					7		8	
R_j Values	63	64	64	67	69	71.5	72	73	73	75	76.5	77	78.5	80	80	
Subgroup	AF	AF	AF	AF	AF	AR	AF	AF	AR	AF	AR	AR	AR	AR	AF	
Sequences			9			10		11	12	13			14		15	
R_j Values	81.5	83	83	84	90	92	92	93	94	95	95.5	97.5	105.5			
Subgroups	AR	AR	AR	AR	AR	AF	AF	AR	AF	AF	AR	AR	AR			
Sequences				16			17	18		19			20			
R_j Values	107	112	135													
Subgroup	AF	AF	AF													
Sequence			21													

r = 21
z = .74554; associated probability = .22797

Table 23. Wald-Wolfowitz Calculations, 23 Requirements.

R_j Value	18	19.5	21	24	26	26.5	27	28	29	30	31	33	36
Subgroup	AF	AR	AF	AR	AF	AR		AF		AR		AF	
Sequence	1	2	3	4	5	6		7		8		9	
R_j Value	36	37	41	45.5	49.5	51	51						
Subgroup	AR	AF		AR		AF							
Sequence	10	11		12		13							

r = 13

$r_{critical}$ = 6

Table 24. Wald-Wolfowitz Calculations, 10 Capabilities.

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